TIMELINE

OF

EVENTS

Sullivan Reclamation Site Accident Timeline

Time	Activity
	May 15, 2006
Unknown (assumed to be AM)	Doug Erickson (DE) arrived on site to conduct routine sampling and monitoring of water flows
1224	A call was made by DE on his cell phone
1224	A call was received by DE on his cell phone
1330	DE meets BC Timber Sales, at Euclid Fuel Area approximately 5 minutes west of accident location. They spoke for approximately 15 minutes.
Between 1345 and 1400	DE's vehicle was observed by Bruce J. Donald (BJD) and Bob Newcombe (BN) in the vicinity of the #1 Shaft Waste Dump
1400	BJD photograph of #1 Shaft Waste Dump shows DE's truck at the accident site. Photo numbers 1006389 and 1006390 have time stamps of 11:04:17 and 11:04:21. Review of the camera Kodak model DC5000 on May 23, 2006 reviews a difference of 2 hours and 55 minutes from the current day actual time determined using Fred Hermann's watch.
Between 1345 and 1400	DE arrived and entered the #1 Shaft Waste Dump Flow Intake building (accident location)
	No other record of outgoing telephone calls or visual contact with DE until his discovery on Wednesday, May 17, 2006
	May 16, 2006
0812	DE's cell phone notes a missed call from ell phone
1150	DE's cell phone notes a missed call from Pryzm Environmental
	May 17, 2006
0659	called DE's cell phone
0700 to 0746	A total of 3 additional missed calls from unknown persons
~0800	called BN requesting a search for DE
~0800+	BN and discussed where DE should be working and agreed to begin a search. BJD reminded BN and hat BJD and BN had seen DE's truck at the #1 Shaft Waste Dump area on Monday.
~0800++	BN and with BJD's cell phone) leave the office in separate vehicles to begin search. BN was going to upper Mine area and to Arena CT-04 and work toward CT-05 and Sludge Pond.
0843 time from BN's	BN called cell to cell) said he had found DE's truck. BN had looked in the building seeing DE

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cell phone	Bob was going to call ambulance, should go to mine gate.
0845 from BN's cell phone	BN called 911 (confirmed by BC Ambulance Call Log) reported a possible sampling shack. Full text of call in 911 wav file #2006.05.17074537
0848 from BN's cell phone	BN called Teck Cominco's to respond to the #1 Shaft Waste Dump area
After 0848 before 1st ambulance arrival	BN entered the building
Between 0848 and 0858	and first ambulance – arrived at accident site. Kim Weitzel (KW) entered the building, started down the ladder, paused to ask if gas was present. She told Shawn Currier (SC) something had happened to his partner and SC entered the building descending immediately, asked KW if she was OK and
0850	Alan Collinson (AC), Acting Fire Chief receives a call for assist from 911 dispatch of at the Sullivan Mine
0859 from BJD's cell phone	places a 911 call Advises 911 that we have 4 people down including 2 ambulance attendants. Mentions possible gas and H2S. Advised by dispatch not to let anyone into the shack. Refer to 911 wav file 2006.05.17075907
0902	meets on road between accident site and mine gate advising him not to enter the building may have gas. Refer to 911 wav file 2006.05.17075907
0903	meets AC on road between accident site and mine gate advising him not to enter the building without apparatus – may be gas Refer to 911 wav file 2006.05.17075907
0905	AC arrives at accident site. One BC Ambulance, One TC ambulance, TC pickup, TC and private vehicle at scene.
0915	Engine arrives at accident sight and prepared to enter building with confined space gear.
0917	Second ambulance – arrives on site establishes triage area.
0922	First patient, KW, removed from the building and taken to triage.
0923	Engine arrives on scene.
0929	Second patient, Shawn Currier (SC) removed from building and taken to triage.

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0933	Third patient, BN, removed from building and taken to triage.
0934	Third ambulance, arrives on scene.
0936	Ambulance arrives on scene and goes to triage area.
0937	First victim, DE, removed from building by
0944	First ambulance, leaves for hospital with KW.
0945	AC notifies Kimberley RCMP to attend scene.
0947	Fourth ambulance, arrives on scene.
0948	Second ambulance, leaves for hospital with SC.
0950	Third ambulance ????, leaves for hospital with BN.
0955	Fifth ambulance, ?????. arrives on scene.
0955-1007	Fourth and Fifth Ambulance leave scene.
1007	RCMP arrives on scene.
1020	Engines and return to station.
1020	Chief Inspector of Mines, Fred Hermann (FH), notified of accident.
1020	Regional Director, Ricci Berdusco, (RB), and manager mining Richard Booth notified of accident by FH.
1040	Richard Booth calls Terry Paterson (TP) and TP is directed to proceed to scene secure the site and control access.
~1025	arrives on scene.
1031	BJD calls MEMPR
~1035	Helicopter landed just south of the accident scene.
~1042	Coroner Gerry McIntyre (GM) arrives on scene.
~1050	FH advised there are four fatalities.
1109	Teck Cominco calls in Emergency Response Team (ERT) from Trail Smelter.
1120	TP on scene and secure site.
~1210	Safety perimeter moved to command center site 200 yards up from main gate access.
1247	Phil Pascuzzi (PP), and Garry MacDonald (GMD), arrives on scene.
1425	AC and confined space team return to scene, conduct air tests, establish safety perimeter and to ensure public was not at risk. Remained on scene until 1623 conducting perimeter gas checks
1500	FH and RB arrived on scene FH assumes control of site.
1500	Teck Cominco senior staff arrives at office location.
1620	arrive with gas testing equipment.
1623	AC and confined space team returned to station.
~1700	DE removed from site.
~1800	ERT arrives on site. Conducts perimeter gas checks.

Sullivan Reclamation Site Accident Timeline

2035	ERT stand down for the day.
~2130	Building locked, site secured, security on site.

Sullivan Reclamation Site Accident Timeline

Air tests taken by Kimberley Fire Department
Using ISC Model TMX-412

Date	Time	Location	H2S	CO	Oxy	LEL
17/05/06	1425	Safe Zone #2	.3 ppm	BDL	21.1%	0
	1427	100 M away from building	1 ppm	5 ppm	21.1%	N/R
	1429	30M	1 ppm	5 ppm	21.1%	N/R
	1431	25M downwind from the building	0 ppm	5 ppm	21.1%	N/R
	1433	8M perimeter of building	0 ppm	5 ppm	21.1%	N/R
	1434	4M perimeter	0 ppm	5 ppm	21.1%	N/R
	1436	NW side 3M	0 ppm	5 ppm	18.0%	N/R
	1436	Downwind side (SW)	0 ppm	5 ppm	18.0%	N/R
	1437	Tester inside the door (in breathing zone)	0 ppm	0 ppm	7.0%	0
	1440	Returned to Safe Zone #2				
	1452	Established safe zone #3 10M				
	1500	Perimeter test	4 ppm	0	21.1%	0
1510 Continuous perimeter monitoring no changes in reading						
	1528	Reading from inside of the building 4 feet down from the platform	0	0	0.7%	5%
1633 returned to the Fire Station Base						

**N/R denotes Not Recorded

Sullivan Reclamation Site Accident Timeline

Air tests obtained by and
Using BW Tester

Date	Time	Location	H2S	CO	Oxy	LEL
17/05/06	1625	Loc # 1 10M perimeter	0	0	20.9%	0
	1640	Loc # 2 At the door ledge	0	0	3.4% Using pump with probe	4%
	1650	Loc # 2 At the door ledge	0	0	9.5% Using pump with probe	0%
	1725	Loc #1	0	0	20.9%	0%
	1726	Loc #3	6 ppm	0	20.9%	0%
	1730	Loc #2 At the door ledge	0	0	7.25 Using pump with probe	5%
1726 reading witnessed by Ricci Berdusco it flashed on screen and returned back to zero						
	1811	LOC # 1	0	0	20.9%	0
	1820	Loc # 4 by the front bumper of pick up truck very close to the shed	0	0	19.9%	0
	1935	Vent Pipe approx. 30M south of Shed	3 ppm	0	20.9%	0
	2010	3900 portal manhole	0	0	20.9%	0
	2020	Pump Station 961/962	0	0	20.9%	0
	2032	Gerry Sorensen Intake	0	0	20.9%	0
May 18/06	0810	Loc # 5 @ incident site approximately 80feet away from the shed 2nd safety zone established	0	0	20.9%	0
0820 BW tester calibrated						
	0915	Loc #5	0	0	20.9%	0
	0927	Loc #5	0	0	20.9%	0
	0928	Loc #2	0	0	15.7%	0
	0945	Loc #1	0	0	20.9%	0
	0955	Loc #1	0	0	20.4%	0
0950 SO2 – 10 pumps less than 0.5ppm at 20 pumps 0.5ppm						

Sullivan Reclamation Site Accident Timeline

0956 CO2 > 3000ppm above the weir in the shed. 0956 LEL varied between 6% and 4% Oxy 0.6% H2S 0ppm						
	1047	3900 portal	0	0	20.9%	0
	1206	Pump Station 961/962 50 feet east of shed	0	0	20.9%	0
	1213	In side of the shed	0	0	20.9%	0
	1300	Gerry Sorensen way intake 15' in front of the door	0	0	20.9%	0
	1301	Gerry Sorensen way intake @ the door	0	0	20.9%	0
	1302	Gerry Sorensen way intake inside first door	0	0	20.9%	0
	1303	Gerry Sorensen way intake 12' inside first and second door	0	0	20.9%	0
	1512	Incident site Loc #5	0	0	20.9%	0
	1513	Loc # 4	0	0	20.9%	0
May 19/06	0110	Perimeter readings outside of shed within 5'	0	0	20.9%	0
	0150	Perimeter readings outside of shed within 5'	0	0	20.9%	0

Sullivan Reclamation Site Accident Timeline

Tests taken below by ERT using handheld analog sampling device with only 2 sensors, Oxygen and LEL						
May 20/06	1040	3900 Portal Outside			21.0%	0
	1045	3900 Portal inside			21.0%	0
	1046	3900 Portal inside manhole			21.0%	0
	1103	Pump Station 961/962 outside			21.0%	0
	1105	Pump Station 961/962 Inside			21.0%	0
	1108	Pump Station 961/962 Inside Lower floor			21.0%	0
	1112	Pump Station 961/962 sump inlet			21.0%	0
	1115	Pump Station 961/962 Sump north of shed			18.5% Probe at water level	0
	1130	Grit Chamber Pump Station			21.0%	0
	1135	Grit Chamber emergency shut off valve out side of door			21.0%	0
	1136	Grit Chamber emergency shut off valve In side of Room			21.0%	0
	1140	Gerry Sorensen Way Intake Outside			21.0%	0
	1141	Gerry Sorensen Way Intake Inside of the first door			21.0%	0
	1142	Gerry Sorensen Way Intake Inside 2nd room			21.0%	0

Sullivan Reclamation Site Accident Timeline

ALL TIMES ARE MOUNTAIN STANDARD TIME (MST)

Sample Location	May 17 Wed	May 18 Thu	May 19 Fri	May 20 Sat
Pipe In-flow (TC)	1730			
1 Ft. above Weir (TC)	1730			
1 ft. below grade plywood floor (TC)	1730			
Opening of Outlet Pipe (TC)	1730			
Upstream Pipe (TC)		~0930		
Bottom of Pit (TC)		~0930		
3900 Portal (TC)		1040		
961/962 Pump Station (TC)		1206		
Gerry Sorenson (TC)		1300		
Sample 1A (MEMPR) At Pipe			~0137	
Sample 1B (MEMPR) At Pipe			~0137	
Sample 1C (TC) at Pipe			~0137	
Sample 2A (MEMPR) 1 Ft. below entry level			~0137	
Sample 2B (MEMPR) 1 Ft. below entry level			~0137	
Sample 2C (TC) 1 Ft. below			~0137	

Sullivan Reclamation Site Accident Timeline

entry level				
Sample 3A (MEMPR) Inside Shed (Breathing Zone) 5 ft above entry level			~0137	
Sample 3B (MEMPR) Inside Shed (Breathing Zone) 5 ft above entry level			~0137	
Sample 3C (TC) Inside Shed (Breathing Zone) 5 ft above entry level			~0137	
Sample 4 (MEMPR) In Fresh Air approx. 300 yds. from incident shed uphill and upwind			0215	
Sample 1 (Rescan for MEMPR) at Portal 3900 inside bldg. at ground elev.				1046
				Additional Samples taken by Rescan...results expected May 23, 2006

All samples were gathered by the ERT (Emergency Response Team) lead by from Trail Operations. Air samples are bag (grab) samples of the atmosphere. Both MEMPR and Teck Cominco had representatives witnessing the sampling.

Sullivan Reclamation Site Accident Timeline

BRITISH COLUMBIA

Ministry of Health

British Columbia Ambulance Service
Kamloops Communication Centre

MEMORANDUM

Prepared by: Doug Garland

Date: May 19, 2006

File:

Re: Sullivan Mine – Kimberley 2006.05.17 – updated 1645 19 MAY 2006

Below is a chronology of events for the above incident – times (PST) taken from Freedom Recording Application unless otherwise noted

Time	Event	Details
0745	Call Received in Kamloops Centre	▪ Tadanack Boulevard, the upper mine, at the toll(?) of the #1 shaft waste dump, Sullivan Mine, Kimberley ▪ Only one main entrance, will have a man there to direct the ambulance ▪ Man may have ne is in a sampling shack ▪ Patient is will be able to access, ▪ Not an operating mine – no mine rescue ▪ Will be able to access the patient – it's a confined area that is the only problem ▪ ear old male
0746		▪ dispatched to the call – location reviewed with male crew member on the phone
0747		▪ assigned the call within the CAD software (CAD time)
0748		▪ 10-8 to call (data head)
0748	Kimberley Fire Dept	▪ contacted – possible call at the Sullivan Mine, upper mine, use the main entrance, year old male has – Tadanack Blvd ▪ Want you to be advised should you choose to respond ▪ Fire asks if we have contacted Search and Rescue, no ▪ EMD indicates to Fire the Kimberley Fire does not do First Response but the (Fire Dept) do rescue
0756	Kimberley Fire Dept	▪ calls back for more detailed location information for r call – they are up on the road and don't see anybody
0757	Kimberley Fire Dept	▪ A/Charge talks to FD – instructed to go to the main entrance – upper mine at the Sullivan Mine ▪ A/ Charge gives information to Fire Department of upper Sullivan Mine main entrance ▪
0758	Kimberley Fire Dept	▪ A/ Charge give additional information - #1 waste shaft – FD informs Cominko truck has arrived – have not seen the ambulance but they took off before we did ▪ EMD attempts to contact – by radio
0759	Mine Calls	▪ ambulance crews are in the hole and have in the hole they are both ▪ must be gas in there as they have .n the hole

		we need more people here as there is no one here ▪ Mine staff says that they have no idea what type of gas might be H2S ▪ Both attendants are ▪ There is no mine rescue – I am here by myself ▪ Fire Dept is on the way ▪ mine staff instructed by dispatch to not let them go in unless they have the proper apparatus ▪ can see them in the hole ▪ one lady (1st attendant) asked if there was gas ▪ ⌐ now on scene ▪ 4 people down in the hole ▪ 2nd ambulance attendant went into the hole and asked "are you OK are you OK" and then ▪ ▪ fire department on scene - they ▪ EMD gets exact directions to the mine gate – go past the Hospital, turn left at the Town Site Grocery, carry straight on meet a the main gate ▪ FD Chief is there, radioed down to the Fire Hall as they did not have any of their breathing equipment with them ▪ Car coming from Cranbrook and another car coming from Kimberley
0800	Dave Brookes (Supt)	▪ paged ▪ paged ▪ paged ▪ both crew members call in
0801		▪ calls in – able to clear in about 5 minutes
0802	Kimberley Fire Dave Brooks (Supt)	▪ Called by A/ Charge – advised possibly H2S – 2 ambulance attendants down – please advise your crews ▪ Calls in – updated on the incident year old male went , the bystander has 2 crew members went in, sounds like H2S, may be up to 4 patients, both crew members have ▪ Paged ▪ assigned the call within the CAD software (CAD time)
0803		▪ both crew members call in
0804		▪ assigned the call to Sullivan Mine
0805	Cranbrook Hosp	▪ Acting Charge notified Cranbrook hospital of 4 patients ▪ Up to 4 patients in probably dealing with H2S – just giving notification, not started transporting yet ▪ Dispatch ticket marked as on route (data head)
0806		▪ Marked on the dispatch ticket as being 10-7 (this is indicated on the dispatch ticket that it was manually time stamped by the EMD)

		▪ 10-8 – no info on the data head – EMD gives the call over the air to the crew – advises crew to stay well clear of danger
0807		▪ calls dispatch to clarify directions
0808	Kimberley Fire	▪ declares a confined space entry – ambulance attendants have entered the space – have activated their confined space crew ▪ no response from ambulance crew ▪ no response from anyone in the hole ▪ breathing apparatus ETA 6 minutes
0809	PAACC	▪ PAACC calls Kamloops offering assistance with staging resources in the Kimberley area ▪ 10-7 scene (datahead)
0811		▪ On scene – 1st two ambulance attendants are down ▪ is on scene – you stay well clear - were (Dispatch) not in touch with – hey might be ▪ is also been responding, keep me updated ▪ The hospital has been notified ▪ EMD advises crew to make sure the do not get themselves in danger
0816		▪ Calls in update – may be 4 down there – our two crew and two more – the fire department just arrived with apparatus – going to patch you to the charge so that we continuity ▪ EMD patches to Charge ▪ Sent ½ way to Cranbrook
0817	PAACC	▪ Kelowna repositioned to pick up DBrooks ▪ 4 down there 2 of our crew and 2 others confined space team on site – – confirmed H2S exposure with Fire Dept – fire department does not know concentrations – cautioned by A/ Charge to be wary of their clothes as sometime they have the H2S on their clothes – member says that but is thankful for the reminder ▪ Calls in for update – still on route – possibly 4 patients down the shaft – couple of those may be our crew members – advised by EMD to stay well clear – is on scene, and have been paged in
0818		▪ Sent into Kimberley for coverage
0819		▪ Paged to call disp – fly to Kimberley ▪ 10-8 sent right into Kimberley
0820		Sent ½ way to Cranbrook for coverage
0822	Charge	▪ Mine site calls back with update – reporting fire and BCAS on scene – Fire has brought their engine with their breathing apparatus – also another group has arrived the confined space team
0824	Cranbrook Hosp	▪ Updates hospital that there are 4 confirmed patients with H2S – now entering the mine with breathing apparatus and mine rescue to try get them out ▪ 1st person been down for about 1 hour ▪ other for about ½ hour

		▪ we have 2 ambulance crew that have gone down – have been down for about 20 minutes
0825	Disp	▪ updates DBrooks – mine rescue they have amassed some sort of mine rescue team an they have fire there going in with the proper apparatus
0826	Kimberley	▪ Discusses location directions with Charge ▪ Called to respond to Mine site for MCI
0828	Invermere	▪ Called to respond to Kimberley
0830		▪ Sent right in to Mine site ▪ 10-7 @ Mine site
0832		▪ states he needs to know where these guys are at ▪ updated two have has been pulled from the tunnel – ot sure who it is – is transporting – the other is on the way up – EMD asked him to call DBrooks
0833	Kimberley Fire	▪ sent to Kimberley ▪ called to update – 2 people out confirmed two other people in the hole as well - 2 other people still in there - 3rd individual removed ▪ updated that – is also responding now ▪ Sent right into Cranbrook
0834	Cranbrook Hosp	▪ Charge updated 2 pts on route both
0835		▪ Calls in update of 3 confirmed ▪ 10-8
0837		▪ member located by disp to move spare unit to airport to transport ALS airevac crew ▪ Sent right into Kimberley
0839		▪ Charge informs regarding Kimberley incident
0840	PAACC	▪ PAACC calls will be in Kamloops in 10 minutes ▪ P.Hecher can go to AirSpan Helicopters AVF – going to
0844		▪ PHecher notified to respond to AirSpan
0845		
0846		▪ Ticket marked by EMD as transporting (CAD time)
0849	DGarland	▪ Ticket marked by EMD as 10-7 scene (CAD time) ▪ Transporting to Cranbrook ▪ Ticket marked by EMD as transporting (CAD time) ▪ Asking for unit to be placed at the Cranbrook airport for airevac crew ▪ Suggested calling direct for CISD
0850		▪ Transporting (data head)
)851		▪ Transporting 1 patient – till on scene – confirms with EMD that there are no other patients needing to be transported
0852		▪ Trauma support calls back
0854		▪ 10-7 at mine
0856		▪ calls EMD asking for times – informed pt is year old

		crew member – asking for help at hospital
0857	A/Charge	▪ calls in asking where they are to be positioned ▪ notified RCMP
0858		▪ sent [illegible] to Cranbrook Hospital
0900	A/Charge	▪ calls [illegible] place on hold ▪ lifts off in Invermere heading for Sullivan Mine Site
0901		▪ calls for update – will attend at the hospital
0902		▪ calls back – Charge asks that they have CIS at Cranbrook Hosp ASAP
0905	Cranbrook Hosp --	▪ called by Charge updated situation and ETA ▪ retrieved both ambulances returning to Cranbrook ▪ ETA to Cranbrook Hosp 5 minutes – other 2 units are about 10 minutes from Hosp
0910	DBrooks	▪ boards [illegible] in Kamloops for Cranbrook
0911	Kimberley Fire	▪ Charge calls to provide CISD contact information ▪ 10-7 Cranbrook Hospital
0912	PAACC	[illegible]out 5 minutes from the hosp ([illegible] has split their crew in two different cars both using the same call sign) ▪ 10-7 hospital (data head) ▪ Calls with updated ETA for [illegible] into Cranbook in 45 minutes, close to 10
0913		▪ Update – both second patients ETA 5 min to hospital
0914	LHarder	▪ Calls in for update from Charge
0915		▪ 10-7 – [illegible] Station ▪ 2nd half of [illegible] 10-7 Cranbrook Hosp
0917		▪ 10-7 Cranbrook Hosp ▪ Ticket marked by EMD as 10-7 (CAD time)
0926		▪ Discusses situation with Charge – Charge updates and offers whatever help they need
0928		▪ Calls in from Mine Site – one [illegible]n scene will carry onto Cranbrook Hosp
0933	Kimberley Fire	▪ Charge calls to inform that a number of firefighters are in Cranbrook and arrangements need to be made to get them back to Kimberley
0935		▪ Approximate time at Cranbrook
0937		▪ 10-7 [illegible] station
0937		▪ cleared for return to Cranbrook
0945	Victoria Disp	▪ Called asking for names of deceased crew
0948	CUPE 873	▪ CUPE 873 office notified of deceased crew members ▪ Calls in with update and confirmation of 1 pronounced crew member
0953	RCMP	▪ Asking for delay of notification of NOK until BCAS management can arrive
0958		▪ Clear [illegible] station
0959	RCMP	▪ Called back to inform there will be a staging area at the Hosp – will try to delay the notification of NOK until BCAS management can be on site
1000	DBrooks	▪ Approximate time touch down in Cranbrook

1006	▪ Charge calls , equesting ETA for Cranbrook – Counselor on route ETA 1 hour
1012	▪ Calls in update that both BCAS crew members are deceased
1013	▪ Confirmed that they have left the airport with DBrooks should be at hosp in 10 minutes
1029	▪ 10-7 stn ▪ EMD places crew on city coverage
	▪

Reads: Sample

Phil

May 15/06

	°C	EC	pH	%O	Wea
MY-06					
MY-19	4.5	29.6	7.48	79.6	
MY-12	5.5	32.6	7.26	90.6	
MY-16	6.0	37.9	7.03	88.9	
CT-04	6.5	57.5	6.87	91.4	
CT-01	6.4	66.0	8.03	93.6	
CT-03	10.3	355	7.48	70.6	
CT-05	5.8	69.6	8.35	94.1	
CT-10	8.1	1646	8.39	83.9	5.75
CT-02	6.2	86.3	7.52	94.0	
82-13					
01-22	6.2	56.3	7.52	94.0	

82-13

Apr 10/06

Depth	0.35				
Width	1.0				
Velocity	2.46	2.56	2.84	2.75	2.56

May 15/06

Depth					
Width					
Velocity					

ARD

Rhl

ARD Pond Peiz											
Pneumatic	JAN 2/06	Feb [illegible]	Mar [illegible]	Mar 19	MAR 30	APR 11	APR 17	APR 24	MAY 1	MAY 8	May 15
01-01	.		.	.	.	.	.	.	.	.	
01-02	.		.	.	.	.	.	.	.	.	
01-03	0.1	0.1	0.1	[illegible]	0.1	.	0.1	0.1	0.1	0.1	
01-04	0.3	0.4	0.6	0.8	1.0	1.0	1.0	1.0	1.0	1.0	
01-05	0.2	0.3	0.6	[illegible]	0.7	0.6	0.6	0.6	0.6	0.6	
01-06	1.1	1.3	1.5	[illegible]	1.6	1.5	1.5	1.5	1.5	1.5	
Standpipe											
SD-01	9.63	8.92	8.38	7.90	7.36	6.37	5.87	5.92	6.05	6.46	7.06
SD-02	2.40	1.84	1.37	1.13	0.79	0.79	0.83	0.91	0.79	1.04	1.20
SD-03	DRY	2.20	2.04	1.44	1.89	2.01	2.03	2.07	1.77	2.01	2.06
ND-01	3.10	3.11	2.95	2.84	2.22	1.83	1.88	1.97	2.00	2.04	2.20
ND-02S	1.92	1.88	1.72	[illegible]	1.30	1.34	1.41	1.47	1.30	1.52	1.57
ND-02D	3.56	3.53	3.52	3.3	3.23	2.77	2.77	2.83	2.84	2.89	3.04
ND-03	1.02	0.99		*0.66	0.45	0.11	0.01	0.03	0.055	0.11	0.20
ARD WEIR (in)	FROZEN	DRY		2.00	2.75	2.50	2.75	2.60	2.50	2.00	1.60
pH											
EC											
947											
948											

Fire
EC.66

pH	2.88	3.13	2.88		2.68	2.94
EC	6340	4350	4600		3550	3520
947	4535.8	4659.4	4823.6		5161.6	5324.7
948	4432.6	4546.5	4712.7		5050.0	5213.1
MY10			24.00		19.50	
MY07			7.00		4.25	
#1 Short site.						
LOL			31.00		27.75	

Peizometers

Apr 29/06

Open Pit

Temp	3.2
EC	233
pH	8.06
%	83.7

100 [illegible]
EC 9.66

RIL 30 MIDDLE LIGHT, ON GROUND FAUL
ARD SHACK, IS ONLY 1/2 ON
HOMETOWN SAYS IT'S THE BULBS

AY 2 FLAT TIRE

AY 3 SCC CHAIN BALLED 954 LINE

4 SCC CHAIN BALLED 953 LINE

Y 5 954 IS PRIMARY PUMP AG

Y 10/06 CLEANED BUILD UP IN SULLY CR. ON F
IN CREEK BED AS MUCH AS POSSIBLE.

y 13/66 - Cleaning silt build-up at Sc
ay 14/06 - Silt build-up again at Amad
on Sully Cr. intake - Cleaning

y 17/06 - STAY AWAY FROM WASTE DUMP
DO NOT ENTER BUILDINGS AT GRIT C
61/62 PUMPS - G. SORENSEN INTAKE
GRIT CHAMBER COVERS. DO NOT ENTE
3700 PORTAL - 3700 PORTAL MANHOL

/06 12:30 FIRE BETWEEN. U
& ARD. CITY FD CALLED
INVOLVED.

ADDITIONAL

WITNESS STATEMENTS

Fire Fighter statement for

On Wednesday morning May 17,2006 I was directed by acting Fire Chief Al Collinson to respond to at the end of Tadanac Blvd. I along with firefighters nd nded with Eng Al Collinson took off a head in the command unit. When we reached the address we stopped to look over the bank to see if there was an ambulance down on the lower mine road as the direction the fire chief received from the dispatch were quite confusing. We were looking to see if there was some one in the creek. The chief had continued up the mine hill towards the dam to see if that were the incident was located. He came into contact with some one from tech cominco and said the incident was at the #1 mine dump. He then returned to the lower mine parking lot and had both nd go with him in the command unit while I returned to the station to activate the search and rescue crew for the rescue of As I reached the station I received a call on the radio for me to contact the city confined space crew and return to the mine #1 dumpsite with a crew and Eng I asked firefighter do a call out for the fire department and to contact the to get the confined space crew, which he did. I along with Fire fighter d hen responded to the mine site.

Enroute we were informed by the Chief that we would require SCBA when we arrived at the scene id donned their protective equipment and rescue harnesses. Both nd I completed the safety checks. Another ambulance arrived and was setting up a triage area. Once and prepared to enter the building with ontrolling the rescue lines. pulled the first paramedic (female) up nd I took her over to the triage area where nd ambulance attendants were located. The second victim (male) attendant was pulled up and we took him to the triage area. Our second team arrived just as we had removed this person and as low on air so long with nd pulled out the third victim and we took him to the triage area. The fourth victim was removed and and we then moved him to an area next to triage. Once we had all the victims removed we had the crews move to a rehab area behind the Command unit. nd I moved ambulances and stretchers around for the ambulance crews and id ssisted n the ambulance to the Cranbrook Regional Hospital.

This statement is accurate to the best of my knowledge.

Respectfully submitted

Dated May 18,2006

MEMO

To: **File:**

From:

Date: **Thursday, May 18, 2006**

Subject: **May 17th confined space rescue**

---

as requested, I will summarize my recollection of yesterday's events.

I initially heard the call via the City radio outside my office and immediately went to the fire hall to see if my assistance was needed. The engine was parked in the street facing east when I got on. You were officer, was driving and nd myself were in the back. On the way up we were informed that the rescue will be a confined space and that we were to get our BA's on.

Upon arrival at the scene, nd I took our BA's off to get our harnesses on when we discovered that there was only one harness on engine . elected to put the harness on and who was already on scene, suggested the he go into the chamber, with his BA on the evaluate the situation. Chief Collinson agrees and I go with to act as safety for him. I had my BA back on at this point. Once in the chamber, indicated that there was 4 victims that he could see and that they were By this time had his harness on and he and acted as the rescue tean in the bottom of the chamber, both tied off on life lines. I acted as safety for both of the guys inside the building on the platform above.

With this crew we managed to get the female paramedic out first. an out of air so wapped places with and he and worked to get the next paramedic out. Basically the two guys below would lift the victim to me and I would pull them to the door at which time the crew out side would transport to the paramedics rescue station The ambulance crew had set up a staging area about 30 metres away from the building.

For the next two victims and (These guys arrived on Engine rom Marysville Station) were the rescue team in the hole. I changed bottles between the first two victims and the second victims. ssisted me as the safety person on the platform above the chamber for the next two victims. Bob Newcombe was the third victim brought out and finally Doug Erikson was brought out. Doug was

The ambulance attendants were to three of the victims during and after the rescue. Ambulances were arriving and taking the victims to the Cranbrook Hospital. and traveled in the ambulances to Cranbrook to assist with

From a timeline point of view, Doug

Weather was hot (+25 C or so) and clear at the time of the rescue.

Other people on site at the early stages were (Kimberley Fire department), nd another paramedic, and the Cominco More ambulance attendants arrived after the rescue to transport and the RCMP showed up (and another constable).

Although we didn't follow our normal procedures for confined space of setting up tripods etc., I felt that we were very safe at all times. All of the rescuers were tied off and I was acting as the "extractor" for our guys should something happen. We encouraged our guys to keep talking, ensured that all the guys had good BA seals and were very careful in the tight quarters.

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Statement of observations and actions for during the Sullivan Mine Deaths on May 17th, 2006.

Role in incident: Firefighter, Kimberley Fire Department.

I am unsure of time of arrival on scene.

We staged our engine (engine # , within 100m est. of the incident scene. My crew partner , and I were advised by our truck officer, , that our role was to don SAR (supplied air respirator) and assist in the rescue of an number of victims, possibly four. Approaching the scene, I observed 2 BC Ambulance, a generic van labeled "ambulance", Kimberley Fire Dept. engine , and command vehicle, as well as a Tech Cominco pick-up and a Nissan Frontier pick-up. At this time two BCAS personnel, and the onsite first aid person appeared to be establishing a triage/treatment area at a distance of roughly 35 feet from the door to the shed.. The four KFD entry personnel on were in the shed with SCBA and coveralls. Two of the four were visible within one to two feet of the door, and the two others were inside the lower compartment. Outside the shed I witnessed KFD members assisting with the entry teams, managing ropes and waiting to assist with moving victims. The entry teams were harnessed and tethered.

My partner and I donned our harnesses and SAR with the assistance of driver) and (engine officer). As we completed donning our equipment the first victim was being removed. This person was the female BC Ambulance attendant. As I was not in my PPE (personal protective equipment), I was unable to assist in the carry of the first victim. During the carry of the first victim we completed the donning of our PPE. and I were then instructed to aid in the lift and extraction of the remaining victims.

Upon entering the shed, the air was clear (no mist, steam or other visible airborne matter). The crew in the lower compartment were lifting the male BCAS attendant. The upper crew were pulling up this victim. My partner and I were assisting with this lift. We carried this victim approximately 10 feet from the shed until adequate personnel took him from us. The low air alarm on the SCBA of one of the crew in the lower compartment began to sound and that crew removed themselves. The crew in the upper shed then moved into the lower compartment to remove the Cominco employee.
and raised by the lower crew and and myself. Then carried to the triage by area by unknown personnel. (to me)
At this time the crew in the lower compartment has a low air alarm and removed themselves from the compartment. A back up team was established and and I then entered the lower compartment. Before climbing entirely down, a KFD member reminded us not to break the seal on our masks as the atmosphere was IDLH. (immediately dangerous to life and health)

Initial observations of the lower compartment were:

Culvert from the rear of the compartment, with water flowing into the compartment.

Estimated 12 inches of water pooled.

Water flowing out of the compartment at the front.

Clear water.

My partner , checked the victim and found him - We then notified the surface crew this will be a recovery so resources could be used to aid in the resuscitation of the victims removed. Removal of the victim was done with a rope and lift assist by myself and surface personnel. Our crew then confirmed no further victims before exiting the compartment.

Upon exit if the shed we then removed our PPE and attempted to aid the BCAS with victim care.

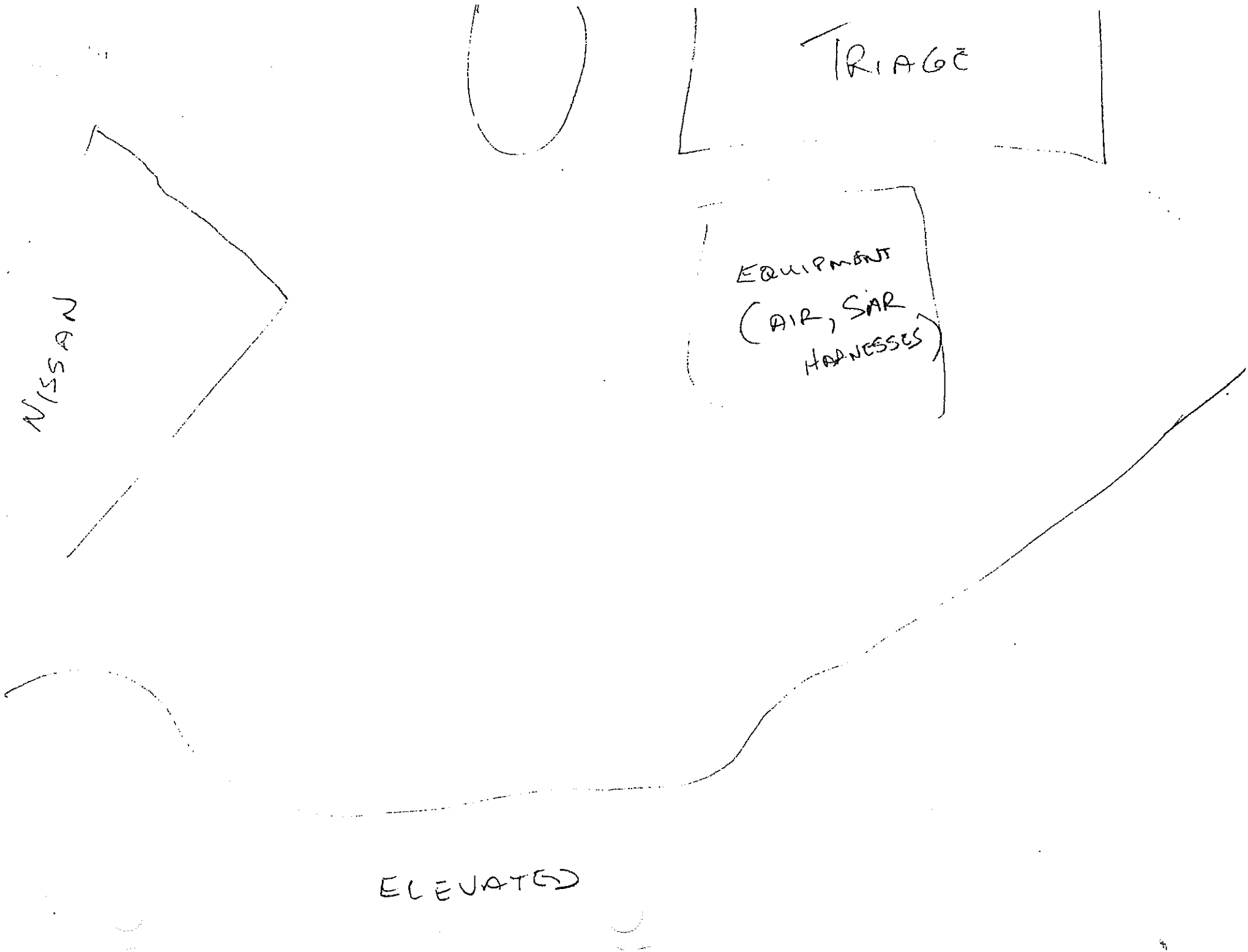
All victims were removed by BCAS, with the exception of the man

I then loaded equipment, marked the shed with fire-tape, and left the scene.

There was no sulfur smell at any time during this event.

This is a statement made to the best of my recollection on this day of May 18, 2006.

Regards,


TRIAGE
EQUIPMENT
(AIR, SMR
HARNESSES)
NISSAN
ELEVATED

Confined Space Report by

While I was working on Wednesday, May 17, 2006, I also was on monitor for the Fire Hall. I heard a call for a . I started to respond then the call came in as a possible 4 person down. Command called for confined space response. As I responded I called to see where he was so he could bring engine to the scene as it has confined space rescue equipment. I arrived at the Kimberley Fire Hall and proceded to the TECK property below the old entranceto the mine. I put on a safety harness and breathing apparatus. When I was given the go ahead, I entered the small building with and together we removed the female attendant. As we started to remove the male attendant, air started to run out. I tapped him on the shoulder and told him his bells were going off which is the signal to let us know when the oxygen supply is running out. exited the confined space and I proceded to male attendant off so we could get him out. Following that, my air was low, I I exited the confined space.
then assisted in loading the patients into the ambulance. When everyone was removed from the confined space, we returned to the Fire Hall. A short time later, I returned to the scene to do some air quality readings with some of the other fire men for the Mines Inspector.

MEMO

STATMENT BY

RE: WED MAY 17/2006 CONFINED SPACES CALL

CALL CAME IN AROUND 09:00 TO 09:05 AS CONFINED SPACES CALL ALL CONFINED SPACE RESCUE TEAM MEMBERS RESPOND. I WAS

WHEN THE CALL CAME IN. WE RESPONDED TO THE MARYSVILLE FIRE HALL RIGHT AWAY. WE RESPONDED TO THE CALL AT 09:11 hrs WITH AS DRIVER, MYSELF AS ENGINE OFFICER, AND AND IN THE JUMP SEAT. WE WERE INSTRUCTED BY CHIEF COLLINSON TO RESPOND TO UPPER MINE GATE WHERE A COMINCO EMPLOYEE WOULD ESCORT US TO THE LOCATION KNOW AS #1 DUMP SITE. LED US IN. WE STAGED AS PER CHIEF COLLINSONS INSTRUCTIONS AND WERE INSTRUCTED BY HIM TO PREPAIR A RESCUE TEAM WITH THE S.A.R.'S. AT THIS TIME ENGINE ALREADY HAD A TEAM IN THE SPACE AND THE SECOND IN AMBULANCE CREW WERE THE FEMALE ~~PAT~~ PATIENT. AS WE WERE SETTING UP THE SAR THE SECOND PATIENT (MALE AMBULANCE ATTENDANT) WAS REMOVED FROM THE SPACE AND I ASISTED CARRYING HIM FROM THE BUILDING TO THE TRIAGE AREA FOR THE AMBULANCE FIRST AIDERS.

AT THIS TIME THE RESCUE TEAM FROM ENGINE WERE AND THE SAR TEAM FROM ENGINE WAS READY WITH SAR'S, 20 MIN EMERGENCY ESCAPE BOTTLES, HELMETS, GLOVES COVERALLS, AND A LIFE LINE TO EACH. THE TEAM WAS AND IN SAR'S WITH ON AIR SUPPLY, MYSELF ON AIR LINE AND LIFELINE MANAGMENT. AT THIS TIME TO BE IN AN SCBA ANY LONGER AND SO DONED HIS EQUIPMENT AND THEN HELPED FROM THE DOORWAY TO LIFT AND REMOVE THE NEXT PATIENT (THE COMINCO EMPLOYEE).

MEMO

I WAS NOW IN CHARGE OF THE AIR SUPPLY FOR THE SAR'S AS WELL AS HOSE AND LIFELINE MANAGEMENT. WITHIN MINUTES THE RESCUE TEAM REMOVED THE LAST PATIENT (THE CONTRACTOR) AND I HELPED TO CARRY HIM TO THE TRIAGE AREA WHERE AND HE ASKED ME TO WHICH I DID. I DID NOTICE THAT,

NEXT I ASSISTED THE AMBULANCE ATTENDANTS IN LOADING THE PATIENT INTO THE AMBULANCES FOR TRANSPORT. UNTIL ALL THREE WERE GONE. THE CONTRACTORS

WE THEN REMOVED ALL THE EQUIPMENT FROM THE FIREFIGHTERS AND PACKED IT UP INTO THE TRUCKS. DURING THIS TIME THE RCMP ARRIVED AND TALKED TO CHIEF COLLINSON AND PHOTOGRAPHED THE SCENE.

. CHIEF COLLINSON INSTRUCTED US TO GO BACK TO THE HALL AND CLEAN UP THE EQUIPMENT WHICH WE DID.

AFTER LUNCH THE MINES INSPECTOR PHIL REQUESTS THAT WE GO BACK TO THE SITED TO DO SOME AIR QUALITY MONITORING FOR HIM. MYSELF,

AND AL COLLINSON WENT TO THE TOP OF THE HILL ABOVE THE SITED AND CALIBRATED THE CITYS TWO TMX-412 GAS TESTERS THAT TEST FOR OXYGEN, LEL, H_2S, AND CO AND ESTABLISHED A SAFE ZONE AT THE TOP OF THE HILL.

AND MYSELF DONNED SCBA'S TO MOVE IN AND MONITOR THE AIR NEAR THE SITED. AND WERE THE BACK UP TEAM. AT THIS TIME AND JOINED US. AND I MOVE IN TO TAKE READINGS AND CHIEF COLLINSON RECORDED AND

MEMO

20 METERS, THEN 10 METERS AND ALL WE GOT WAS LOW READINGS OF H_2S 4 TO 6 PPM. WE THEN DID THE PERIMETER OF THE BUILDING, AT ~~[illegible]~~ THIS POINT WE GOT LOW OXYGEN OF 19.0 % ON THE BRAVO SIDE OF THE BUILDING. OXYGEN WAS NORMAL ON THE CHARLIE AND DELTA SIDES. ON THE ALFA SIDE AT THE DOORWAY AT WAIST HIGHT WE GOT 10 % OXYGEN LEVELS. I THEN REACHED INTO THE SHED 3' AND THE OXYGEN LEVEL DROPPED TO 7.0 %. WE THEN RETURNED BACK TO THE SAFE ZONE. THE SECOND TEAM RETURNED TO THE SHED TO RIBON OF A 2 METER PERIMETER AROUND IT. AFTER THEY RETURNED WE ALL MOVED IN TO A CLOSER POSITION OUTSIDE THE 2 METER PERIMETER. AT THIS TIME THE 20 METERS FROM THE SHED. THE MINE INSPECTORS, COMINCO PEOPLE, RCMP, AND CORRINOR THEN MOVED IN TO INSPECT THE SCENE I MONITERED THE PERIMETER OF THE RIBON WITH THE AIR TESTING EQUIPMENT THE ENTIRE TIME.

NEXT WE AND MYSELF, USED A REMOTE TESTING PUMP TO TEST THE AIR 4' BELOW THE THE DECK IN THE ENTRANCE OF THE SHED WERE THE LOCATION OF THE PATIENTS. THE AIR AT THIS LOCATION WAS 0.7 % OXYGEN 0 PPM CO, 0 PPM H_2S, 5 PPM LEL. WE DID THIS WITH FULL SCBA'S ON. SHORTLY AFTER THAT THE AND WE WERE ABLE TO PACK UP OUR GEAR AND LEAVE BACK TO THE FIRE HALL. JUST PRIOR TO LEAVING AN AIR TESTING CREW FROM THE ELK VALLEY ARRIVED TO TAKE OVER FROM US.

UPON RETURN TO THE HALL WE ALL MET WITH A CRITICAL INCIDENT COUNCILLER FOR ABOUT 1½ hrs.

To Chief Allen Collinson;

The following is my statement of the events of the "confined space " rescue of May 17th,2006.I received a page-out calling for a confined space team and engine to the upper mine site.I arrived at the Marysville station moments later and responded with :nd .We arrived on scene to find command,engine ,2 ambulances and two civilian vehicles.We brought out the confined space gear and proceeded to set it up and myself donned harnesses as . and set up the air supply manifold.As we were doing this the first victim was being removed by the first teams to arrive.When we had our gear on and were ready to go,we assisted in moving the second victim to the paramedics.At this time team one members were running out of air.I entered the structure followed by .I lowered myself into the space below where was trying to secure the third victim.I helped to secure and raise the victim to ..I then proceeded to secure the final victim.At this point, exited the lower space and came down to help.I managed to

The other members of the team above took him and exited.I then did a quick search of the space and which I tossed up to the entrance and I then climbed out and exited.

Upon leaving the building,I took off my mask and air lines and proceeded to assist paramedics with Shawn. . and myself helped load Shawn into an ambulance.We were then asked to proceed to Cranbrook with the patient.We to the patient along with a paramedic until we reached the emergency room.We were there unti arrived and drove us back to Kimberley.

Kimberley Fire Department

May 18, 2006

To Whom It May Concern:

Re: May 17, 2006 Statement of

- Approximately 900 hours, I drove Engine to the scene with and nd the rear seats. On route to the scene, we were informed of four casualties in a confined space. This information was relayed to us through

- Upon arrival to the scene, myself, and proceeded to don our Self Contained Breathing Apparatus. Through this procedure, we were receiving direction from Allen Collinson, Kimberley Fire Dept. Fire Chief.

- id myself proceeded to join another fire fighter, at the outside entrance of the Water quality Station. At this time, we performed a safety check procedure prior to the rescue.

- d ntered the building with their life lines attached to their backpacks. and I had the life lines in our hands.

- went part way down the ladder and confirmed that the bodies were there. At this point, bserved that the handrail was in the way. He ripped it out to aid in the rescue procedure.

- proceeded to the female paramedic. d I assisted in the lift to the surface where there was Paramedics and Fire Fighters waiting for her.

- ttempted to retrieve the second Paramedic, however his low air alarm sounded and he exited the building.

- whom was behind went down the ladder and the second Paramedic myself and other rescuers assisted to take the body out to awaiting Paramedics and Fire Fighters.

- I proceeded to go down the ladder next. I a third casualty male. ssisted me in bringing up the third casualty to awaiting Paramedics and Fire Fighters.

- My air supply at this point was at around half a tank

- At this point, and went down to retrieve the last casualty. I assisted with lift of this casualty to the awaiting Paramedics and Fire Fighters.

- Once the recoveries had taken place, I

- I assisted with loading the second and third casualties onto the ambulance stretchers.

- I was very confident with the entire recovery procedure of this situation. The communication between the team members involved was very professional and effective.

Sincerely

We arrived on scene with 4 men onboard.
I went down to the building and started to set up air packs.
After setting up I put on a SCBA and switch out with
I went into the building and help to bring out Last 2 people.
After all the people were out we started putting people into
ambulances. We then cleaned up and

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors

EMERGENCY HEALTH SERVICES COMMISSION OCCURRENCE REPORT

PAGE 1 OF 7

(DD / MM / YYYY)	DATE OF RESPONSE OR INCIDENT (DD/MM/YYYY)	RESPONSE NO.	OPERATOR NO.
2 0 5 2 0 0 6	1 7 0 5 2 0 0 6	P-247558	
ER		EMPLOYEE NO.	CAR NO.
NDANT Hecher, Peter		EMPLOYEE NO	

Sullivan mine Respone

0930 - Call from Dispatch to Attend to the Sullivan mine in Kimberley as I/C. Dispatch States Two mine people down + 2 crew members down . Possible H2S Gas. Dave Brooks flying back from Kamploops with Aircare Team. 0950 - Lift off Invermere Airport to Kimberley (Airspun 206LR). Talked To Pilot sat H2S Gas, states he had Training In the Gas due to flying around Gas wells. 1025 - landed at Sullivan mine 2 R.C.M.P and other person on Scene one code 4 Talked to Cpl , 2 Ambulance People and one other person on route to Hosp in Cranbrook CPR in Progress Cpl States all Pts had Passed away, Dispatch Notified

Tasked

Truck

☐ Dispatch called via cell form back of Truck

Bank

X Landing Site walked up to R.C.M.P.

DATE (DD / MM / YYYY) 2 2 0 5 2 0 0 6

RE(S)

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors

EMERGENCY HEALTH SERVICE COMMISSION OCCURRENCE REPOR

DATE (DD / MM / YYYY)	DATE OF RESPONSE OR INCIDENT (DD/MM/YYYY)	RESPONSE NO.	OPERATOR NO.
22/05/2006	17/05/2006	P-247558	
RIVER		EMPLOYEE NO.	CAR NO.
TTENDANT		EMPLOYEE NO.	
Hecker			

E: (cont)

10:30 - Lift off for Cranbrook Hosp.
10:40 - Landed at Cranbrook Helipad. at Hosp. walked To Admin building. Saw

Talked to for about 1 min went inside and saw and he told me that Kim Weitzel is Dead and the Dr's are still working on Shawn Currier. called Dispatch to form them. Then called Air Dispatch to release the Helicopter.

went to the ER and talked to Dr ? He stated all three had died, Kim at 10:29 and Shawn at 10:52. Phoned Dispatch to let them know Found out C.I.s person was on the way. went back and talked to Dave Brooks arrived with Airevac team and Dave asked me to Try and Get some info from people.

works for Sullivan closer Company. Bob called (2nd Person to Die) called. Then hung up the Phone went to Scene met Fire Dept told them

(S)

DATE (DD / MM / YYYY) 22/05/2006

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors

EMERGENCY HEALTH SERVICE
COMMISSION OCCURRENCE REPOR

DATE (DD / MM / YYYY)	DATE OF RESPONSE OR INCIDENT (DD/MM/YYYY)	RESPONSE NO.	OPERATOR NO.
22/05/2006	17/05/2006	P-247558	
DRIVER		EMPLOYEE NO.	CAR NO.
ATTENDANT Hecher		EMPLOYEE NO.	

E: (Cont)

Where to go. ~~Meet~~ met Someone driving out in Pickup with Comino markings told possible H2S Gas not to go in.

ON ~~Scene~~ Scene, found Ambulance running with lights on. He found Bags on top of ~~ladder~~ ladder yelled into hole No Answer. Backed away. Fire Dept on Scene he stopped to fire men that wanted to go

Kimberley Fire / Rescue, F/C,

~~went~~ arrived on Scene mine person ~~Meet~~ met them on Road, stated H2S Gas not to go in. Fire States 6 foot hole, little building 6x6? Jump bag and O2 at Door way. ladder down to hole 6'? they called down no one answered They bucked off called city to get confined space team. Scba came to Scene, 2 firefighters went down, brought people out one at a time. Kim Weitzel brought out 1st, Shawn Currier 2nd, Bob 3rd, Doug 4th out every one recieved on 4th Person (Doug)

K(S)

DATE (DD / MM / YYYY) 22/05/2006

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors

EMERGENCY HEALTH SERVICE
COMMISSION OCCURRENCE REPOR

DATE (DD / MM / YYYY)	DATE OF RESPONSE OR INCIDENT (DD/MM/YYYY)	RESPONSE NO.	OPERATOR NO.
22/05/2006	17/05/2006	P-247558	
DRIVER		EMPLOYEE NO.	CAR NO.
ATTENDANT Hecker		EMPLOYEE NO.	

E: (Cont)

Car Kimberley.

Dispatch called call on car, to go to mine - met Person at Scene ? told them 2 miners down and 2 Ambulance staff. Waited for Fire Rescue, set up triage area with ~~Tarp~~. Kim out 1st shawn out next (they split). order they came out they were transported (shawn Currier) Drove.

Car Kimberley, Talked to in Building, Jump bag and O2 on top of stairs Waited for fire Dept with Scba, ropes, harnes Fire went in. Kim 1st up, 15 min in hole? Turned lights off in 1st Ambulance, Drove back on Kim Weitzel

Dispatch called out home mine worker down, 2 firemedics went after them. said he was going up there. At Scene 3 people, 2 firepeople

SIGNATURE(S)

DATE (DD / MM / YYYY) 22/05/2006

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors

EMERGENCY HEALTH SERVICES COMMISSION OCCURRENCE REPORT

PAGE 5 OF 7

ATE (DD / MM / YYYY)	DATE OF RESPONSE OR INCIDENT (DD/MM/YYYY)	RESPONSE NO.	OPERATOR NO.
22052006	17052006	P-247558	
IVER		EMPLOYEE NO.	CAR NO.
TENDANT Hecher		EMPLOYEE NO	

(cont)

. Fire brought 4th person out d on .

Drove (car Cranbrook) sta

Cranbrook 1st car that left.

car Cranbrook called at 904, to mine in Kimberley, 3rd car in, 3 Pts on Scene called Dispatch, informed them crew down and one other Pt.

drove + 2 fire fighters on 3rd person?

-At Stop Sign 1/2 way to Cranbrook Switched.

- Called on cranbrook at 0900 to Stn, 10 min at stn Dispatched Phoned cross cover Kimberley routie. 10 min out of Cranbrook, Dispatch called them, 4 Pts at the mine, to mine at 0930, got there as 1st Pt Ambulance was leaving with 1st Pt (Kim) Pulled in got out drove one Ambulance back (3rd Pt?)

called on cranbrook 9:00 to Stn unknown, Paged again 1 min later said Stn Coverage. 10 min at Stn, Phoned, head to Kimberley coss- cover At field, upgraded to to mine

RE(S)

DATE (DD / MM / YYYY) 22052006

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors

EMERGENCY HEALTH SERVIC COMMISSION OCCURRENCE REPO

PAGE 6 OF 7

DATE (DD / MM / YYYY)	DATE OF RESPONSE OR INCIDENT (DD/MM/YYYY)	RESPONSE NO.	OPERATOR NO.
22/05/2006	17/05/2006	P-247558	
DRIVER		EMPLOYEE NO.	CAR NO.
ATTENDANT Hecher		EMPLOYEE NO.	

REF (Cont)

leaving with 1st Pt as they accessed [redacted] to Scene, Drove 1/2 way then Switched with (Shawn) ?

1330 — and I at Cranbrook Stn. Grant working on Car coverage with myself

1300? - called Kimberley stn, talked to + states to get Dawn Brooks up here they found out on Radio about what happened. Tried Calling Dave no answer. Doug Garland Superintendent Dispatch called and asked if I could start working on getting coverage for Kimberley Stn. He would Fax Stn lists to Cranbrook Stn. U/C office locked unable to access Fax, called Cranbrook, Said he would come and open office. Dispatch called and asked if I could go to Kimberley Stn to help crew. 1520. left for Kimberley, Dropped off at Airport. 1605 at Kimberley Stn only 2 people there. called Doug Garland to fax lists to Kimberley Stn. Dispatch stated 2 crew (Golden) members driving up to Kimberley to Cover night Shift. Started working on Getting coverage. One car covered until Sunday Am.

DATE (DD / MM / YYYY) 22/05/2006

BRITISH COLUMBIA
Ministry of Health and
Ministry Responsible for Seniors

EMERGENCY HEALTH SERVICES COMMISSION OCCURRENCE REPORT

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22/05/2006	17/05/2006	P-247558	
IVER		EMPLOYEE NO.	CAR NO.
TENDANT		EMPLOYEE NO.	
Hecher			

(Cont)

Union, management, friends, co-workers started showing up at Kimberley Stn.
19:00 Left Kimberley to return home, 20:30 arrived at Stn in Invermere Drove Back our Zone Spare

DATE (DD / MM / YYYY) 22/05/2006

BRITISH COLUMBIA EMERGENCY HEALTH SERVICES COMMISSION

AIREVAC CREW REPORT

OPERATOR'S COPY

HLTH 2456 Rev. 87/09

26. REG'N STATION: 4 | 1 | 1 | D — SHIFT
27. DATE OF SERVICE: DD 17 MM 05 YY 06
28. PRIOR. CODE ① ②

SURNAME

PATIENT'S GIVEN NAME — INITIAL

POSTAL ADDRESS

CITY — 5. PROVINCE — 6. POSTAL CODE

PATIENT'S PHONE # — 8. BIRTHDATE DD MM YY — 9. AGE — 10. SEX ① M ② F

M.S.P. I.D. # — 12. S.I.N. #

PATIENT'S PHYSICIAN

BILL TO: (NAME IF NOT ALREADY INDICATED)

POSTAL ADDRESS

CITY — 17. PROVINCE — 18. POSTAL CODE

BILL TO/IDENTIFICATION

Patient, M.H.R., W.C.B., I.C.B.C., Non-resident, Employer, ⑦ Standby, ⑧ Parent, ⑨ D.I.A., ⑩ D.N.D., ⑪ A.G. Canada, ⑫ Coroner, ⑬ Sheriff, ⑭ A.G., B.C., ⑮ Home Care, ⑯ Police, ⑰ I.H.T./T.R., ⑱ M.H.A., ⑲ R.C.M.P., ⑳ Other, ㉑ M.H.A. Trans., ㉒ Cont. Call, ㉓ Cancelled, ㉔ Pt. Refused, ㉕ A.N.U. (circled)

TIMES
20. CALL RECEIVED: 0930
21. TAKE OFF #1: 0950
22. DESTINATION #1: 1025
23. TAKE OFF #2: 1030
24. DESTINATION #2: 1040
25. CLEAR

29. AMBULANCE IN PAST 24 HRS. Y ① N ② UNKNOWN ③

30. REG. RESPONSE #

31. PROV. RESPONSE: P-2475

32. ATTENDANT #

33. ATTENDANT NAME

34. ATTENDANT QUALIFICATION: ① EMA ② EMA II ③ EMA I.V. ④ EMA-D ⑤ ALS I ⑥ ALS II ⑦ ITT ⓪ A/EVAC.

35. ESCORT NAME(S)

36. ESCORT QUALIFICATION: ① EMA ② EMA II ③ ALS I ④ ALS II ⑤ A/EVAC ⑥ NURSE ⑦ M.D. ⑧ TECH.

MISSION DATA

37. REFERRING M.D. — TELEPHONE #

38. RECEIVING M.D.

39. TRANSPORT ADVISOR/CO-ORDINATOR

40. ATTS. ① ② — SUCC. Ⓨ

41. AIRCRAFT TYPE: ① Jet ② Prop ③ Turbo Prop ④ Rotor (circled) ⑤ B.C. Government (call letters): ⑥ Charter Co.: Aerospan 206 LR

42. CABIN ALTITUDE

52. CHIEF COMPLAINT

43. PATIENT ORIGINATING POINT — 44. HOSP. CODE — 45. HOSP. ① A/P ② SCENE ③

46. DEPARTURE SITE: Invermere Airport

47. PRIORITY ① (circled) ② ③

48. LANDING SITE: E K R H

49. TRANSFER: HOSP. ① ALS ② EMA ③

50. DESTINATION HOSPITAL — 51. HOSP. CODE

53. MECHANISM OF INJURY/HISTORY OF PAST ILLNESS

Called by Dispatch
dead mine in
Sorley as IC.
no one left at Scene
Flew to Cranbrook Hosp
nd but IC until
we Brooks Superintendent
could take over.

RELEVANT PAST HISTORY

MEDICATIONS

ALLERGIES

ASSESSMENT

57. VITAL SIGNS: TIME, B.P. SYS. DIA., PULSE, RESP RATE, RESP. EFFORT, CAP. REFILL — INI, FIN

58. COMA SCORE: E V M TOTAL

59. EXAM: State of Consciousness, H & N, Chest, C.V.S., Abd., Back, Ext., C.N.S., Blood Loss

61. TS 1 — 62. TS 2

63. PUPILS: Equal ①, React ②, Dilat. ③, Const. ④, Rt. Lg. ⑤, Lt. Lg. ⑥, Other ⑦

64. SKIN: Normal ①, Cyanotic ②, Pale ③, Flushed ④, Diaph. ⑤

60. DIAGNOSTIC AND ADDITIONAL COMMENTS

No Pts Transported

65. DISPATCHED — AS — DIAGNOSIS 1° 2°

Dispatched	AS	1°	2°
Bowel Disturbance	01	25	49
Chest Pain - Angina	02	26	50
Chest Pain - MI	03	27	51
Coma	04	28	52
Congestive Failure	05	29	53
Drug/Alcohol OD	06	30	54
Facial Injury	07	31	55
Fractures	08	32	56
G.I. Blood	09	33	57
Head Injury	10	34	58
Hemothorax	11	35	59
Infectious Disease	12	36	60
In-flight Death	13	37	61
Neuro - CVA	14	38	62
Obs./Maternity	15	39	63
Ocular Injury	16	40	64
Organ Donor - Trans.	17	41	65
Pneumothorax	18	42	66
Psych. Behaviour	19	43	67
Respiratory/SOB	20	44	68
Seizure	21	45	69
Spinal	22	46	70
Trauma	23	47	71
Other	24	48	72

AIRWAY CONTROL

67. OXYGEN: ① Cannula ② Mask ③ Venturi; O_2 at ___ %; O_2 at ___ lpm

68. I.V. Attend. Ⓨ — TIME — ATTS. SUCC. ① ② ③ — SIZE — SOL'N: ⑧ Album ⑦ Blood ① D5W ② D10W ③ NS ④ RL ⑤ Other — TOT. VOL. (ml)

69. PRE FLIGHT CODES

70. PROTOCOL CODES

71. PATIENT FOUND

72. PATIENT POSITIONED

73. PATIENT TRANSPORT

74. HOSPITAL SELECTED — INITIAL — CODE

MEDICATIONS AND PROCEDURES — 77. RESP. RATE — 78. PULSE — 79. B.P. SYS. DIA. — 80. CARDIAC RHYTHM — 81. RESULT

ADDITIONAL REPORTS — 83. UC - IMC INITIAL — ATTENDANT'S SIGNATURE

Kimberley Str

PETER HECHER
SCENE NOTES

~~May 17/06~~ K P-247558 - DISPATCH TICKET Peav.

2 people down in Mine Kimberly

9:30 - Call from Dispatch 2 - crew members down Kimberly
9:50 - Lift off Invermere Airport to Kimberley (Airspan)
10:25 - Landed Kimberly mine, 2 R.C.M.P on Scene one Code 4. Talked to Cpl 2 Ambulance people and one other person on ~~to~~ route to Hosp in Cranbrook.
Dispatch notified
10:30 - Lift off to Cranbrook.
10:40 - Down at Cranbrook Hosp.

Kim Weitzel 10:29 called } when came to Hosp
Shawn - Currier - 1052 called. } car to Hosp

Air Dispatch } Kimberley car.

Dispatch Called out home dispatch mine
worker down, 2 Paramedics went after them.
said he was going up there. At Scene
3 people on Trap. Shawn
by herself Kim, 2 fire people?
on other person. Brought 4th person out
helped

to Cranbrook 1st car that left.

19-1

-work for Sullivan closer company
- Bob called 2nd man in, emergency. Ambulance called
-went to Scene with , meet Fire Dept told them where to go.
-Meet Someone driving out works for comino was in there truck, he told possible H2S gas not to go in.
- On Scene Ambulance on Scene running with lights on
- Bags on top of latter in building, yelled in no Answer.
Firedept came on scene, he stopped them from going in.
- ~~waiting~~ wait for Suba gear to show up.
Kim then went to Bob stayed with him to hosp-

CW

- Called on , call on air, mine went to FD Scene
- Meet Person at Scene, Told them 2 miners down and 2 Ambulance staff.
- Waited for Fire for Rescue, Set up triage area with traps set every thing up. Fire brought her out
- Kim out 1st,
- Shawn out Next,
order they came out Transported drove,

Start in [redacted]

[redacted]

- Called for Talked to in building
Jump back, and up on top of stairs.
- waited for Fire Dept with Scuba. poles, harness for Fire, went in.
- Kim 1st up, ?
- Turned lights off in #, 1st Ambulance.
- Drove, Kim.

- called on at 0900 + Start to
Stn. 10 min, Dispatch Phoned Cross Crow Kimberly
- 10 min out of Cranbrook, Dispatch called 4 pts need them at once. 0930
- got there as 1st Pt was leaving
- Pulled in got out, drove one Ambulance back 3rd Pt.

- to mine in Kimberly
- 3rd car in, 3 Pt on scene.
- called Dispatch, informed them, 2 crew down and one other Pt.
- and 2 Fire, Shawn
- At At Step Sign,
- Drove,

Called on 9:00 called, unknown
Paged again 1 min later, said Stn coverage:
- 10 min at Stn, Phoned heard to kimberly cross-cover
- field, upgrad to to mine.
- leaving with 1st Pt. as they ~~carried~~ arrived 2 Fire.
- went to scene, Drove 1/2 way, Shawn

Kimberley Fire/Rescue
F/C

Fire/resuce ~~arrived~~ arrived on Scene, B.C. Ambulance on Scene
.. one Person met them on Road, states H2S Gas
not to Go in. Fire states 6 feet hole, little building
6"X6'. Jump Bag and o2 at Door way ~~lat~~ latter
down to hole 6', they called down NO one answered
They backed off, called city to get confineed
Space team, Scuba came to Scene, 2 firefighters
went down brought People out one at a time
Kim Weitzel, brought out 1st, shawn. Cursor 2nd
Bob 3rd Doug 4th out
4th person

~~NOT~~ NO bigger then 10'X10'?

.30 - ard I ~~[illegible]~~ at Cranbrook stn.
working on Car coverage

13:00 - called Kimberley stn, talked to stn to get Dave Brooks up here they found out on Radio about ~~what~~ what happened.

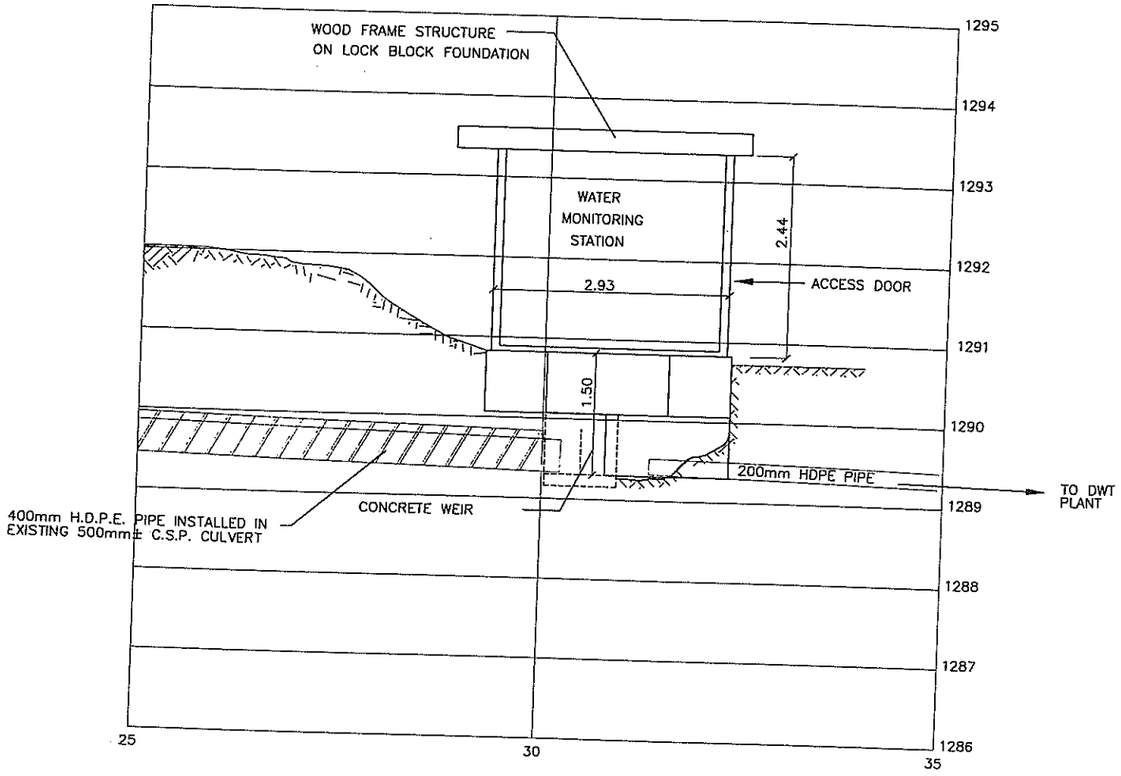
- Working on Getting coverage for Cranbrook stn with Arrow

5:20 - Left for Kimberley, Dropped off

.5 at Kimberley Stn

REPROFILED No.1 WASTE DUMP

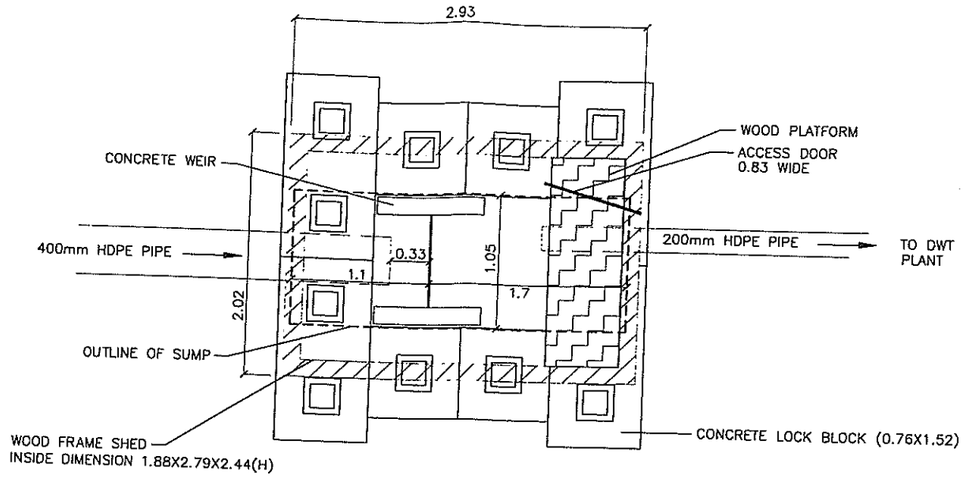
1m TILL COVER (2005)



WEST FACE

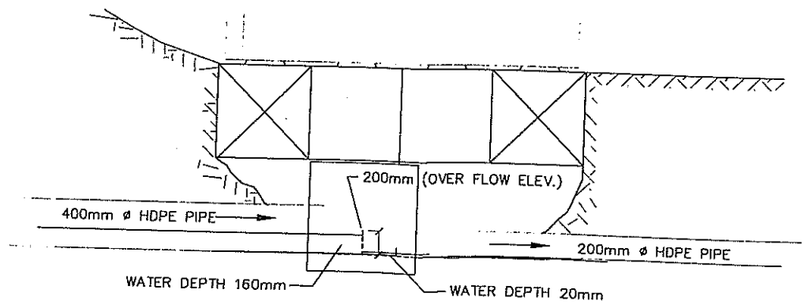
SEE DRAWING K100A3193R1

1:75 (Metric)



OVERHEAD VIEW

1:50 (Metric)

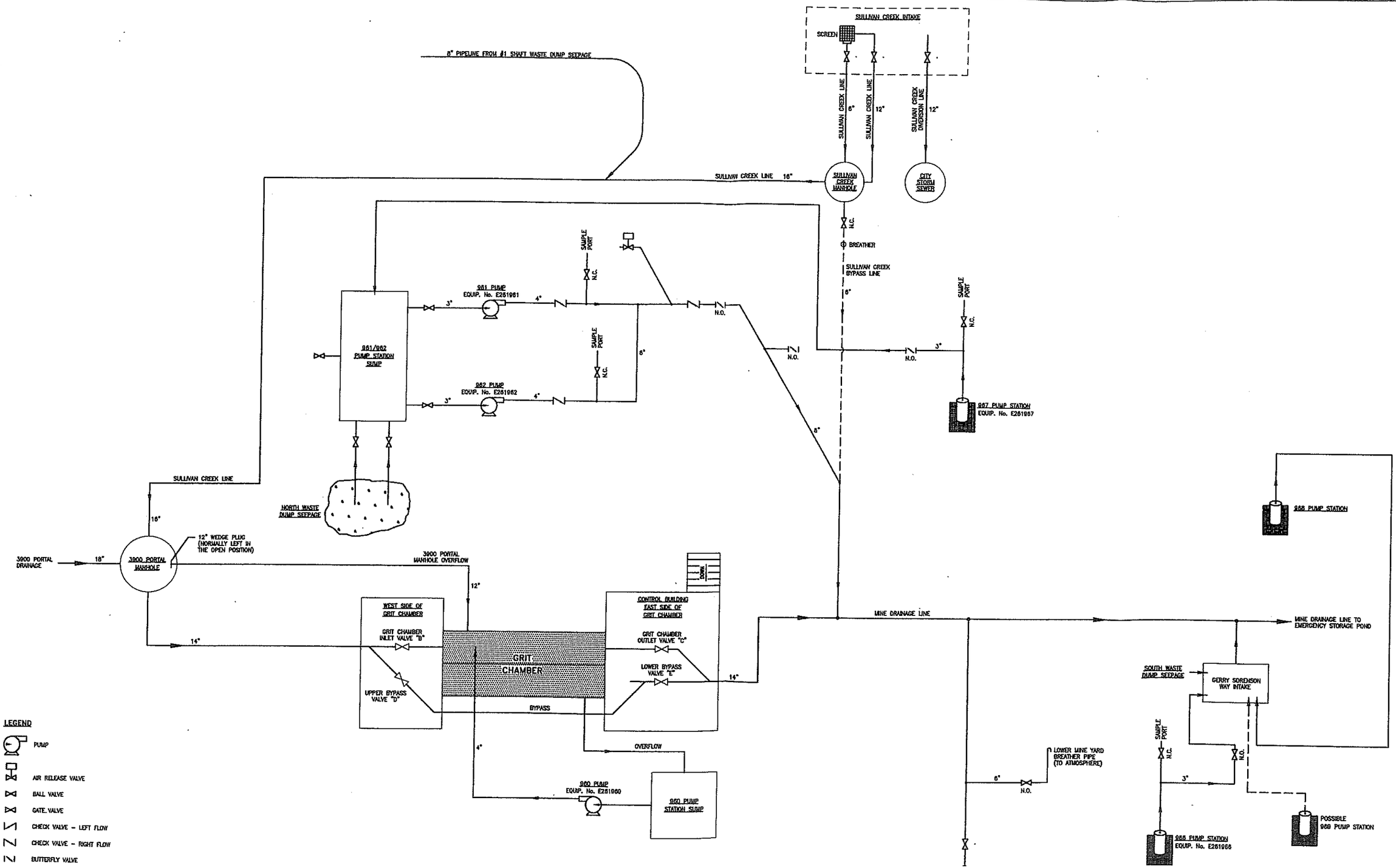


WEIR DETAIL

1:50 (Metric)

WATER DEPTH RECORDED
AUGUST 15TH, 2006

Drawn by	Function	DWT DRAWINGS	teckcominco Engineering Kimberley, B.C.
Checked by	Activity	MINE POST CLOSURE	Revisions: No. / By / Date
Approved	Section	SEEPAGE COLLECTION	
Issued to	Job	No. 1 WASTE DUMP WATER MONITORING SHED ASBUILT WEST VIEW AND OVERHEAD VIEW	
	Scale: AS SHOWN	Date: AUGUST 15, 2006	K100A3196 Rev. 0



OLD DRAWING # K69A797

Job No.: JOB										
Drawing No.	Revision	Issued to	Issued to	References	Rev.	Mods by	Date	Approved	Description	Drawn by: DRAFTER / DDATE
K69 A 3004	4			K69-E-3002 (KIMBERLEY OPS. SEEPAGE COL. SYS.) K69-E-3003 (MINE DRAINAGE AND L.M.Y. SYSTEM) K69-E-3005 (TAILINGS POND AND D.W.T. SYSTEMS) K69-E-3008 (TAILINGS POND & D.W.T. 1 LINE DIA.)	4	C.F.G.	2/9/00		REVISE SULLIVAN CREEK INTAKE	Checked by: CHECKER / CDATE
					3	C.F.G.	11/8/99		SULL. CR. REV., GRT. CH. VALVE DES. REV.	Design Eng.: DESIGNER / DEDATE
					2	C.F.G.	5/4/99		ADDED 3900 PORTAL MANHOLE	Proj. Eng. / Approved
					1	C.F.G.	10/30/98		ADDED SULLIVAN CREEK INTAKE	APPROVE / APPROVE / APPROVE

teckcominco
Engineering
Kimberley, B.C.

Function	DWT DRAWINGS
Activity	MINE CLOSURE
Section	SEEPAGE COLLECTION (LMY)
Job	SINGLE LINE DIAGRAMS
Scale: SCALE	
Drawing No.	K69 A 3004
Revision	4

CAD_FILE: LAST UPDATE: FEB. 19/2005

The University of British Columbia

The Centre for Environmental Research
in Minerals, Metals, and Materials,
The Norman B. Keevil Institute of Mining Engineering,
6350 Stores Road, Vancouver, B.C., V4M 1J2

Tel: 604-822-3984
Fax: 604-822-5599
Email: cerm3dir@mining.ubc.ca
Web Site: http://www.cerm3.mining.ubc.ca/

Sullivan Mine gas samples: Isotope Tracing: A Preliminary Study

June 14, 2006

1.0 Background

Four samples were delivered to UBC-CERM3 for isotope tracing, in connection with the Sullivan Mine accident on May 17, 2006. The samples were collected from the water sampling location where the accident occurred. The samples and their composition (as analyzed by Cantest) are shown in Table 1.

Analysis of Components in Gas

CLIENT SAMPLE IDENTIFICATION:	Downstream Pipe	Upstream	Middle	Bottom		
CANTEST ID:	605180109	605180112	605180113	605180114	DETECTION LIMIT	UNITS
Methane	10.7	12.0	11.4	9.5	2	mL/cu. m
Carbon Monoxide	<	<	<	<	1	mL/cu. m
Carbon Dioxide	7.0	7.0	7.0	6.0	1	% by vol.
Oxygen	2	2	2	3	1	% by vol.
Nitrogen	91	91	90	89	1	% by vol.
Nitrous Oxide	13.3	12.5	12.8	12.9	0.3	mL/cu. m
Trichlorotrifluoroethane	<	<	<	<	0.1	mL/cu. m
Chlorodifluoromethane	<	<	<	<	0.05	mL/cu. m
Dichlorodifluoromethane	<	<	<	<	0.1	mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v) **% by vol. = percent by volume**
< = Less than detection limit

Table 1: Gas samples collected from Sullivan Mine site and their Composition (as analyzed by Cantest)

It can be seen that carbon dioxide is a major component of the gas samples. Identifying the source of this gas is believed to provide an important piece of information in the analysis of the situation. The sampling shed (where the accident occurred) is located at the toe of the west dump (WD1) which is more than 50 years old. Considering the history of the dump, it has been postulated that carbon dioxide may have originated from organic material (known to be buried in the dump). An alternative source for the carbon dioxide is inorganic carbonates which are reportedly present inside the dump and which act as buffering capacity for Acid Rock Drainage. To distinguish between these two possible sources, an analysis for carbon-13 was performed.

2.0 Theoretical basis

Carbon has two naturally-occurring stable isotopes: ^{12}C (98.89%) and ^{13}C (1.11%). The ratio of these isotopes ($\delta^{13}C$) is reported in ‰ relative to a standard sample that is commonly the standard VPDB (Vienna Pee Dee Belemnite).

$$\delta^{13}C = \frac{^{13}C / ^{12}C_{sample} - ^{13}C / ^{12}C_{standard}}{^{13}C / ^{12}C_{standard}} \times \frac{1000}{1}$$

The $\delta^{13}C$ of the atmosphere is about -7‰, similar to the standard sample.

Typical plants, soil organic matter, soil CO_2, marine organic matter, and fossil fuels tend to have $\delta\ ^{13}C$ values in the range from -20 to -30‰. This depletion of ^{13}C occurs because the process of photosynthesis–on land or in the sea–preferentially uses the lighter carbon from the available CO_2 pool. The carbon fixed by plants will therefore have a $\delta\ ^{13}C$ value that is less than that of the source CO_2. This carbon shift is generally in the range of -20 to -30‰.

Trumbore & Druffel, (1995) have given the isotopic range of different sources of carbon as shown in Figure 1.

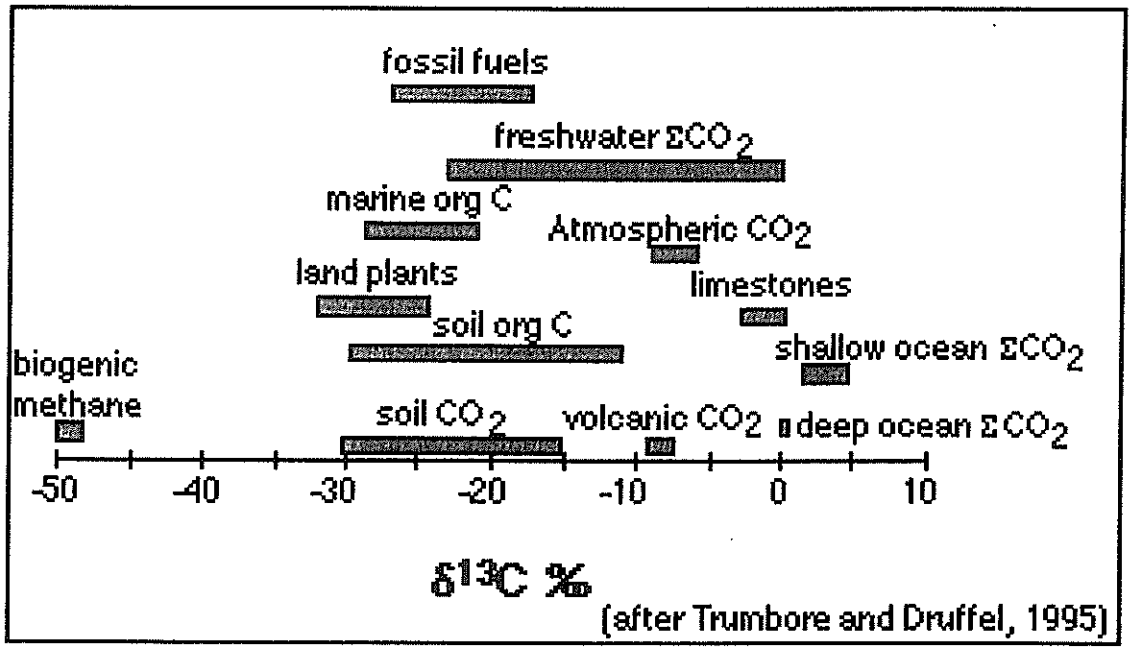


Figure 1. $^{13}C/^{12}C$ ratios are expressed relative to a standard as $\delta^{13}C$ values,

Note that limestones show the least shift (with $\delta^{13}C$ ranging from 0 to -4) while organic carbon, on the contrary, is distinguished by a comparatively large shift (from -15 to -30, in most cases). This bimodal distribution of carbon isotopic ratios provides a valuable tool to distinguish between organic and inorganic sources of carbon. (Kump, 1991, Kwon & Schnoor, 1994, Trumbore & Truffel, 1995).

3.0 Isotope data and interpretation

The four gas samples were shipped to the Hatch Isotope Laboratory in Ottawa for isotope analysis of carbon dioxide. Oxygen-18 and carbon-13 were analyzed in the samples. The data are presented in Table 2.

OurLabID	Sample ID	$\delta^{13}C$	$\delta^{13}C$ Comment	$\delta^{18}O$
C-20993	S#605180114	-8.58	0	-10.47
C-20994	S#605180112	-8.61	0	-10.38
C-20995	S#605180113	-8.87	0	-10.52
C-20996	S#605180109	-8.61	0	-9.91
C-20997	S#605180109 QC Duplicate	-8.28	0	-9.71

Table 2. Oxygen and carbon stable isotope values of CO_2 from Sullivan Mine gas samples.

Note that all samples demonstrate relatively the same isotopic signature. The downstream sample (# 09) is slightly heavier (i.e. richer in both O-18 and C-13), but the difference is insignificant. The carbon shift is too low to attribute the source to organic matter. The shift is close to that of carbonates or freshwater CO_2. While an organic source for the gas can be ruled out, a clear link to waste dump carbonate cannot be established with the present data. Isotopic analysis of carbonates present in the waste dump is necessary to confirm this correlation. Isotopic values of CO_2 in local fresh waters are also needed for the final analysis, since a portion of the CO_2 may be linked to recharge waters.

Similarly, the oxygen-18 values of the samples can be linked to the source of the carbon dioxide. In general, the oxygen isotope composition of organic material is determined by the isotopic composition of the source soil and water. Significant enrichment in $\delta\ ^{18}O$ is commonly observed in most organic material. The main enrichment takes place in leaf water due to transpiration.

At first glance, the oxygen-18 of the samples appears too low to speculate on organic sources. The ratio is similar to that of ground waters. A comprehensive stable isotope study including ground waters and waste rocks is necessary to establish a clear link between isotopic values of the analyzed rocks and the source material.

Considering that the sampled carbon dioxide may also be carried by mine effluent, different water bodies (contributing to the waste dump recharge) and local precipitations should as well be analyzed to find their characteristic O-18 and Deuterium values. These isotopic signatures help (in combination with chemical signatures) to find the source of effluents in mining environments (Ghomshei & Allen, 2000a, 2000b, Lepitre et al, 2000).

Respectfully submitted:

Mory M. Ghomshei, Ph.D., P.Eng., P.Geo.
Email: mory@interchange.ubc.ca
Adjunct Professor of Mining Engineering

4. References

Ghomshei, M.M., and Allen, D.M. (2000a). Potential application of oxygen-18 and deuterium in mining effluent and acid rock drainage. Environmental Geology, 39(7), 767-773.

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Lepitre, M.E., D.M. Allen, J. K. Mortensen, M.M. Ghomshei. (2000). Use of Stable Pb, O-18, and D isotopes for investigating acid rock drainage (ARD) at the Sulivan Mine, British Columbia. Proceedings of Geological Society of America–Cordilleran Section, Vancouver, 2000.

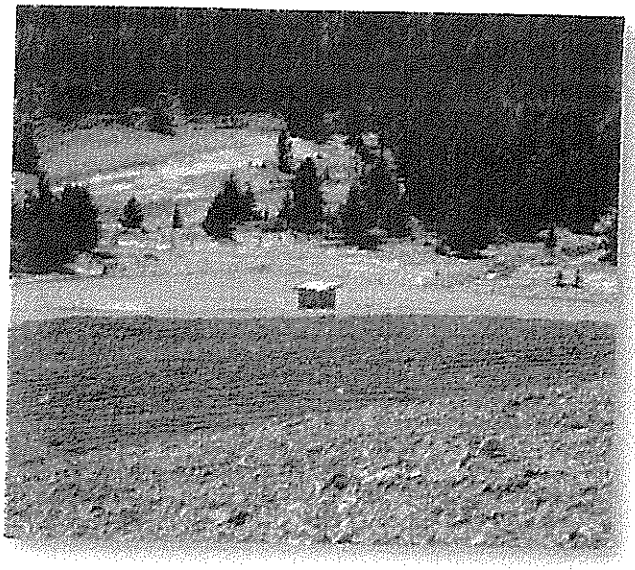
Trumbore, S. E. and Druffel, E. R. M. 1995 Carbon isotopes for characterizing sources and turnover of non-living organic matter. In Zepp, R. E. and Sonntag, Ch., eds., The Role of Non-Living Organic Matter in the Global Carbon Cycle. Berlin, John Wiley & Sons, 7-22.

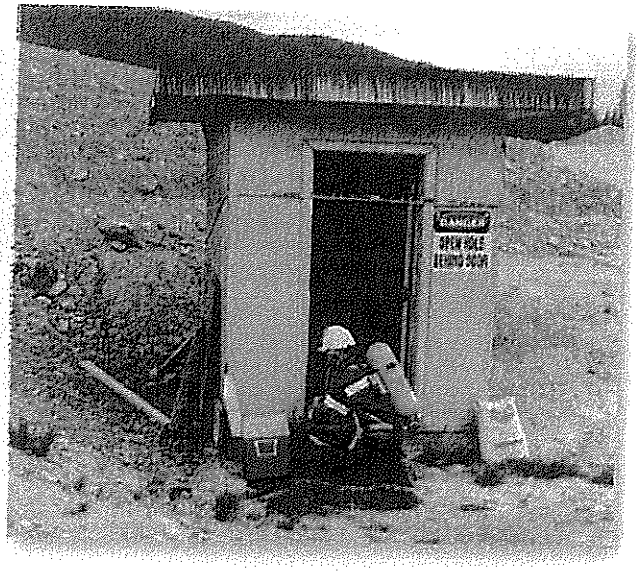
BRITISH COLUMBIA | Ministry of Energy, Mines and Petroleum Resources

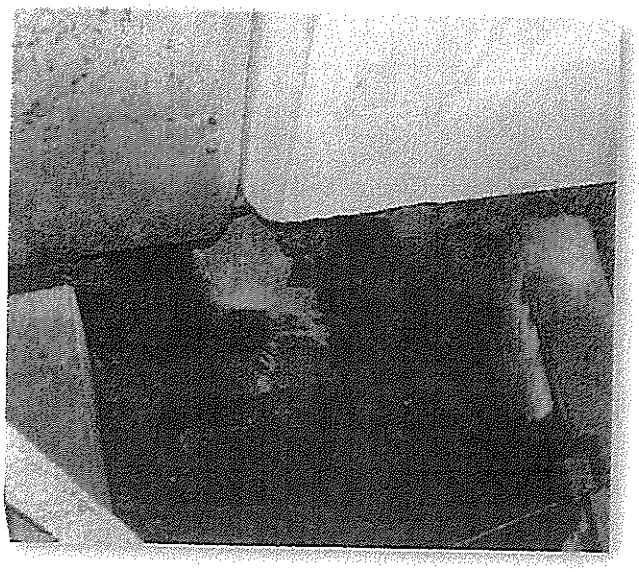
Sullivan Mine Incident Investigation

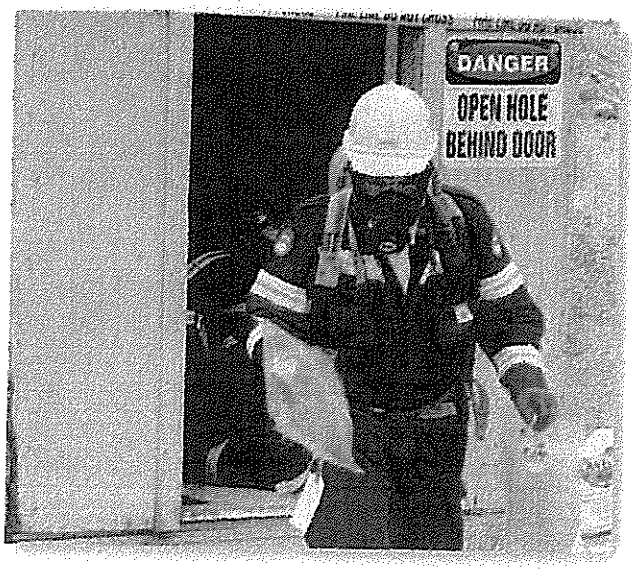
May 15 to 20, 2006

Independent Air and Water Quality Sampling and Measurements









August 2006

Prepared by:
Rescan™ Environmental Services Ltd.
Vancouver, British Columbia

EXECUTIVE SUMMARY

Executive Summary

The investigation into the four tragic fatalities at the decommissioned Sullivan Mine on May 15 and 17, 2006 showed that the incident was caused by oxygen-depleted air displacing ambient air inside a shed. Oxygen-depleted air produces no warning symptoms, such as dizziness. The oxygen concentration inside the shed was approximately 2%. At oxygen concentrations below 6%, two breaths can cause a person to lose of consciousness, with death following within minutes (EIGA, 2003).

The shed where the incidents took place was constructed over a waste rock leachate collection sump at the toe of a topsoil covered waste rock pile. The sump was constructed down-gradient from a culvert and a drainage pipe extending into the base of the waste rock pile. The oxygen depletion was caused by sulphide oxidation reactions within the covered waste rock pile. The topsoil cover was placed on the waste rock pile by Teck Cominco in an effort to curb acid rock drainage (ARD) by impeding oxygen transfer to the sulphide-containing waste rock.

The acid rock neutralization reactions produced carbon dioxide, which partially replaced the consumed oxygen. The cooler and denser oxygen-depleted air inside the waste rock pile flowed down-gradient through the culvert and into the shed. Increasing daytime air temperatures, falling barometric pressure, air composition differences and local air pressure differences provided the driving force for the down-gradient air flow.

The widely published accounts of the Sullivan tragedy have helped to increase awareness of the very real hazards associated with working in and around confined spaces. Future efforts should be focused on strengthening awareness and enforcement of section 3.4 of the *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEM, 2003). The existing regulations provide clear guidelines for appropriate working procedures.

However, identification of confined spaces may not be sufficient to prevent future incidents. Whether or not it flows into a confined space, any culvert or large pipe with an appreciable outflow of oxygen-depleted air constitutes a hazard. An unwitting person looking into a pipe, culvert, or other vent that is discharging oxygen-depleted air could succumb to asphyxiation in a few seconds. Therefore, special attention must be paid to any openings that allow for air transfer between a covered reactive waste rock pile and the ambient air. A safe perimeter around the openings should be fenced off and warnings should be clearly posted. Established procedures for working in and around confined spaces should be followed when accessing such sites.

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Sullivan Mine Incident Investigation

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1. OVERVIEW AND SCOPE OF INVESTIGATION

1. Overview and Scope of Investigation

On Monday, May 15, 2006, Douglas Erickson lost his life during a routine visit to an enclosed sump at the decommissioned Sullivan Mine in Kimberley, B.C. Two days later, on May 17, 2006, Teck Cominco employee Robert Newcombe , succumbed at the site while attempting to rescue Erickson. Paramedics Kim Weitzel and Shawn Currier subsequently succumbed at the site while attempting to rescue Newcombe and Erickson. Later in the afternoon of May 17, 2006, the four victims were removed from the shed by fire fighters from the Kimberly Fire Department, who were equipped with self-contained breathing apparatus (SCBA).

The British Columbia Ministry of Energy and Mines (BC MEM) and Teck Cominco promptly launched an investigation into the tragic incidents. The initial investigation focused on collecting data that would help determine the cause of the incidents. Teck Cominco collected air samples from the scene of the incidents on the morning of May 18, 2006. Another set of air samples were collected at the site by BC MEM on the night of May 18, 2006. All sampling was carried out by Teck Cominco's volunteer hazardous materials (HazMat) team.

Rescan Environmental Services Ltd. (Rescan) were asked by BC MEM to conduct a site inspection on May 18, 19 and 20, 2006 and to collect an independent set of air and water quality samples from the site of the incidents. The samples were intended to supplement those collected by Teck Cominco and BC MEM on May 18, 2006.

The fatal incidents took place in a shed (2.41 m high, 2.02 m wide, and 2.02 m long) constructed over a waste rock seepage collection sump at the toe of a soil-covered waste rock pile (Plate 1-1 and 1-2). The sump was 1.68 m below the floor level of the shack. The waste rock pile had been covered by topsoil in early 2006 by Teck Cominco as part of the reclamation efforts at the decommissioned Sullivan mine. The inflow to the sump consisted of a culvert with a partially buried PVC pipe installed inside it (Plate 1-3 and 1-4). Before the topsoil cover had been placed on the waste rock pile the culvert had drained water from a French drain constructed along the perimeter of the waste rock pile. The outflow of the sump drained through another PVC pipe to a catchment sump for delivery to the St. Mary's water treatment plant (Plate 1-5).

The objectives of the air and water quality sampling were to determine the composition of the air inside the shed and the seepage collection sump and to characterize the seepage water running into the sump. In addition, samples for microbial activity were collected.

This report describes the field sampling methods and analytical results for the collected air and water quality samples. The chemical and physical processes that likely caused the oxygen depletion at the scene of the incidents are discussed and recommendations for preventing similar fatalities are presented.

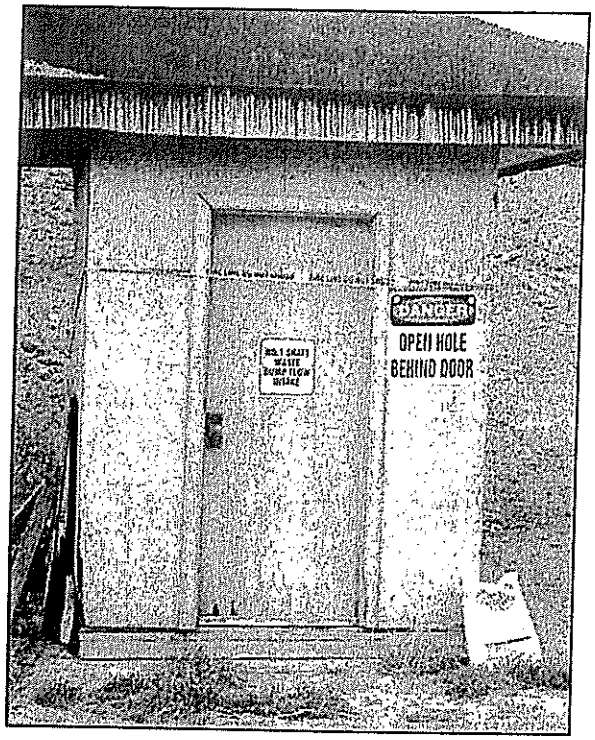


Plate 1-1 The shed at the decommissioned Sullivan Mine where the asphyxiation deaths of four people occurred on May 14 and 16, 2006.

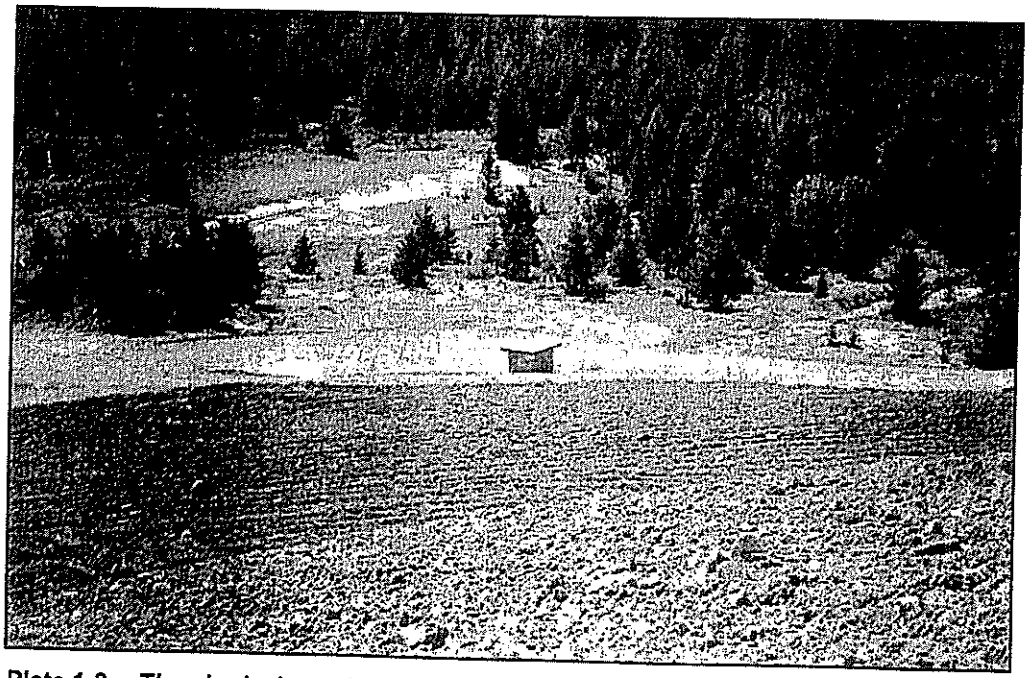


Plate 1-2 The shed where the fatalities occurred, situated at the toe of the reclaimed waste rock pile.

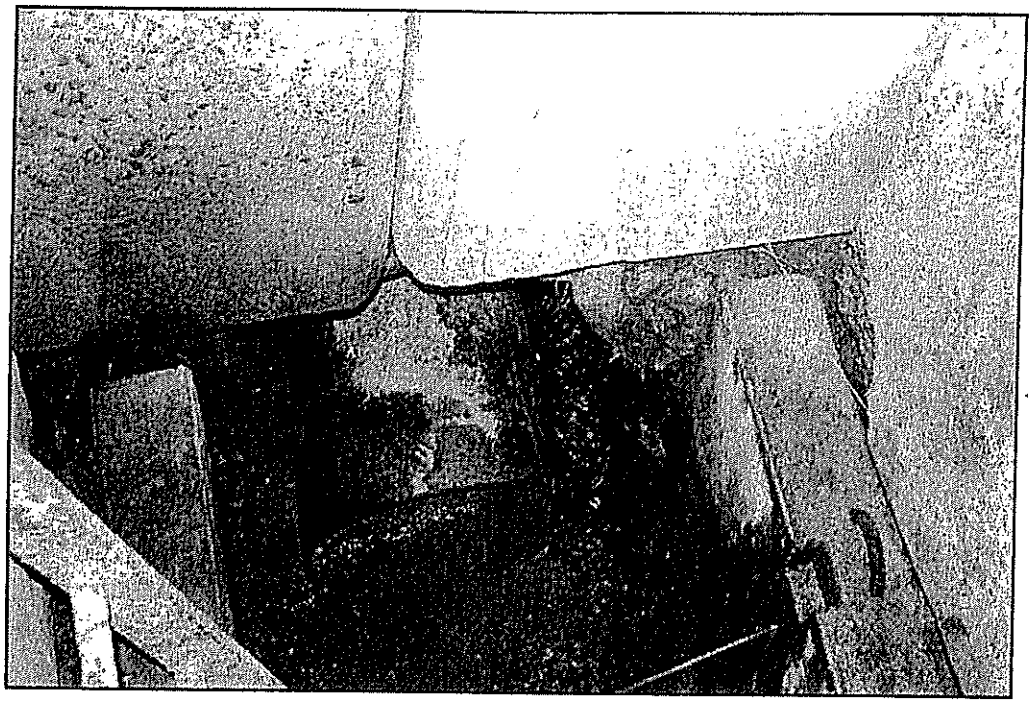


Plate 1-3 **A PVC pipe at the bottom of the sump inside the shed. The pipe, which was the conduit for exhausting the oxygen-depleted air, is installed in a culvert (not pictured) that drains waste rock seepage to the sump.**

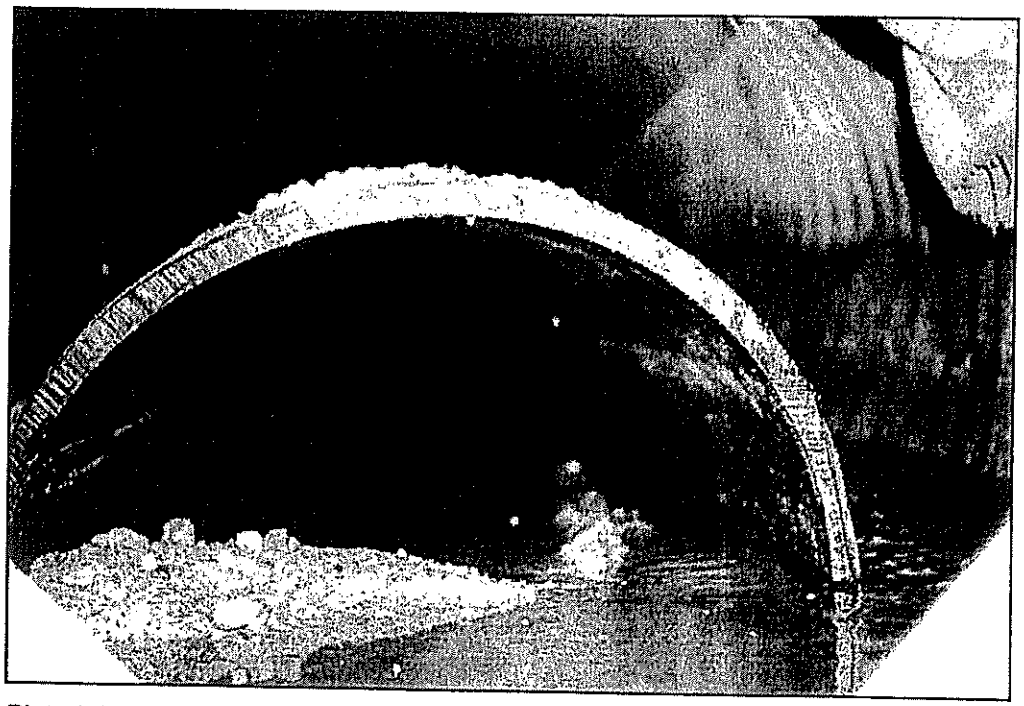


Plate 1-4 **End view of the partially sanded PVC pipe at the bottom of the sump; the culvert leading into the bottom of the waste rock pile surrounds the pipe.**

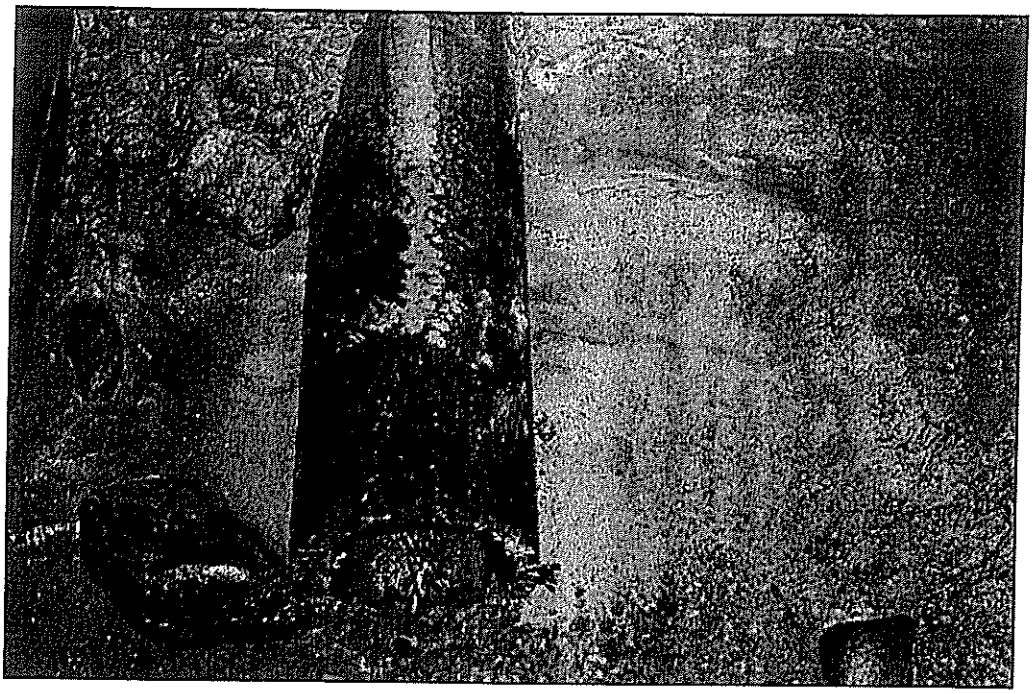


Plate 1-5 The outflow pipe at the bottom of the sump.

2. FIELD SAMPLING METHODS

2. Field Sampling Methods

2.1 Air Quality

CANTEST Laboratories of Vancouver, B.C. supplied Rescan with 1.0 and 5.0 L air quality sample bags (Tedlar bags). The 1.0 L bags were new while the 5.0 L bags had been used previously and certifiably cleaned by the CANTEST. The sample bags, along with a hand pump and sample tubing, were delivered to Rescan by courier on May 19, 2006. The air quality samples were treated as legal samples; the required chain of custody forms and seals were supplied by CANTEST.

The field sampling was carried out by volunteers from the Teck Cominco HazMat team who were each equipped with SCBA (Plate 2-1).

Rescan personnel provided the HazMat team members with detailed instructions on air sampling procedures. The air quality sample apparatus consisted of a 50 cm stainless steel tube (with an inside diameter of approximately 5 mm) attached to Teflon tubing and a rubber bulb with a one-way valve (hand pump). Sample bags were labelled by Rescan personnel and given to the HazMat team members. The 1.0 and 5.0 L sample bags were filled to approximately 80% capacity according to sample protocol. The Tedlar bags were then handed back to Rescan personnel, who had witnessed the sampling from a distance. The sample bags were sealed and signed according to legal sampling protocol. The air samples were placed in 34 L plastic coolers, which were legally sealed, and the appropriate chain of custody forms were filled out.

Air quality samples were collected at five locations in the following order:

1. **Near the ceiling of the shed:** The door to the shed was opened just enough to allow the HazMat team members to fit the stainless steel sample tube over the top of the door to collect an air sample near the ceiling of the shed (Plate 2-1).
2. **Inside the pipe draining into the sump:** HazMat team members climbed into the sump wearing SCBA and collected the air sample.
3. **At grade inside the sump.**
4. **At the floor level inside the shed.**
5. **At the Sullivan Mine 3900 level portal sump shed.**

One sample from each sampling location was provided to Teck Cominco for independent analysis.

In addition to air quality samples, the HazMat team measured the velocity of the air flowing from the pipe to the sump. On-site measurements of air temperature were made using a YSI 30 temperature sensor.

Plate 2-1 Teck Cominco HazMat team members collecting air quality samples from the shed at the Sullivan Mine (8:00 AM, May 20, 2006)

2.2 Water Quality

On-site measurements of temperature, conductivity, pH and dissolved oxygen of the seepage water in the sump were completed following the air quality sampling. The measurements were taken by Teck Cominco's HazMat team members using the following calibrated, digital, hand-held instruments:

- a HANNA Instruments HI 9143 dissolved oxygen meter was used to measure dissolved oxygen and temperature;
- a YSI 30 conductivity and temperature sensor was used to measure conductivity and temperature; and
- an OAKTON waterproof pH tester was used to measure pH.

Detailed instructions on how to operate the instruments were provided by Rescan personnel.

Water quality sample bottles were supplied by ALS Environmental of Vancouver, B.C. The water quality samples were treated as legal samples and the required chain of custody forms and seals were provided by ALS Environmental.

Teck Cominco's HazMat team collected the samples as instructed by Rescan personnel (Plate 2-2). Samples were labelled and given to the HazMat team member who proceeded to

collect the water quality sample. One duplicate sample was collected from the seepage water draining from the culvert inside the sump between 8:20 and 8:25 AM on May 20, 2006.

Plate 2-2 Teck Cominco HazMat team members collecting water samples from the shed at the Sullivan Mine on May 20, 2006

After sampling had been completed the samples were handed back to Rescan personnel who added the required preservative, sealed the samples and placed them in coolers containing ice packs. The water quality samples were transported with the air quality samples to Rescan's Vancouver laboratory on May 20, 2006 where they were placed in secure storage. On May 23, 2006, the samples were delivered by Rescan personnel to ALS Environmental Laboratories for analysis, after the required chain of custody forms were completed. A detailed list of parameters included in the analysis and analytical results are presented in the following section.

2.3 Microbial Activity

Sample bottles for microbial activity samples were supplied by IG MicroMed Environmental in Richmond, B.C. The samples were not treated as legal samples. One duplicate sample was collected from the seepage water draining from the culvert inside the sump. The samples were analyzed by direct microscopic count and by plate count.

The samples were collected by HazMat team members and transported along with the water quality and air quality samples to Rescan's Vancouver office on May 20, 2006. On May 23, 2006, the samples were transported to IG MicroMed's laboratory in Richmond, B.C.

3. RESULTS

3. Results

3.1 Air Quality

The results of the on-site measurements on May 20, 2006 at 8:15 AM were:

- ambient air temperature: 14.1° C;
- air temperature inside the culvert: 8.9° C; and
- velocity of air flowing from the pipe to the sump: 90 ft/min (0.46 m/s).

HazMat team members reported that the velocity of the air flowing from the pipe on May 18, 2006, at 9:00 PM was 168 ft/min (0.85 m/s).

The results of the air quality analysis of the samples collected by Rescan on May 20, 2006, are summarized in Table 3-1. Analytical test methods and results are presented in detailed in the air quality analysis data report from CANTEST included in Appendix A.

Table 3-2 shows a summary of the air quality analysis results for the samples collected by Teck Cominco at 9:00 AM on May 18, 2006. A detailed data report from CANTEST is included in Appendix B. Table 3-2 shows a summary of the air quality results for samples collected by BC MEM on the night of May 18, 2006. The samples were analyzed by ALS in Edmonton; a data report is provided in Appendix C.

The analysis of the air samples collected by Rescan on May 20, 2006 showed that the air inside the pipe and near the bottom of the sump was almost completely depleted of oxygen, with concentrations of 2% (Table 3-1). The concentration of nitrogen was between 90 and 91%, which is 11 to 12% higher than normal ambient nitrogen concentrations. Carbon dioxide concentrations were measured at 7%, approximately 200 times higher than ambient concentrations. Nitrous oxide concentrations were relatively low, at 12.4 and 12.7 ppm. Total hydrocarbon concentrations were equal to methane concentrations at 10.8 and 8.1 ppm upstream in the culvert and at grade in the sump, respectively. Carbon monoxide, sulphur dioxide, hydrogen sulphide and volatile organic compound (VOC) concentrations were all below analytical detection limits.

The composition of the air samples collected by Rescan in the pipe and near the bottom of the pit were similar to the composition of samples collected by Teck Cominco and BC MEM on the morning and night of May 18, 2006 (Table 3-2 and 3-3): 2 to 4% oxygen, 90 to 92% nitrogen and approximately 6% carbon dioxide.

The first air quality samples, collected near the ceiling of the shed before the door had been fully opened (Plate 2-1), contained 12 to 13% oxygen, 83% nitrogen and 3% carbon dioxide. The last air quality sample, collected near the floor of the shed (samples 3A and 3B), contained near ambient concentrations of oxygen (20%) and nitrogen (78%), while carbon dioxide concentrations were approximately eight times higher than ambient concentrations. At that time

Table 3-1
Air Samples Collected by Rescan on May 20, 2006 at 8:00 AM: Summary of Analytical Results (CANTEST)

Sample ID		1A	2A	3A	3B	TOPA	TOPB	BAG1	BAG2	
Location	Units	Upstream in Pipe	Bottom of Sump	Inside Shed at Grade		Along Ceiling of Shed		3900 Level Portal Pipe Discharge		Typical Ambient Air[1]
Oxygen (O_2)	% (v/v)	2	2	19	20	13	12	20	20	20.946
Nitrogen (N_2)	% (v/v)	91	90	79	78	83	83	78	79	78.084
Carbon dioxide (CO_2)	% (v/v)	7	7	0.257	0.284	3	3	0.0502	0.0532	0.035
Carbon monoxide (CO)	ppm (v/v)	<1	<1	<1	<1	<1	<1	<1	<1	-
Methane (CH_4)	ppm (v/v)	10.8	8.1	<2	<2	8.4	5.6	<2	<2	1.7
Nitrous Oxide (N_2O)	ppm (v/v)	12.4	12.7	0.98	0.95	6.2	6.7	0.4	0.4	<0.5
Total Hydrocarbon	ppm (v/v)	10.8	8.1	<2	<2	8.4	5.6	<2	<2	-
Sulphur dioxide (SO_2)	ppm (v/v)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
Hydrogen Sulphide (H_2S)	ppm (v/v)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-
Volatile Organic Compounds (VOCs)[2]	ppm (v/v)	All 39 species included in the analysis were below detection limit in all samples.								

Notes:

<: indicates concentrations less than stated detection limit.

1: Source: CRC Handbook of Chemistry and Physics and NASA Earth Fact Sheet: http://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html.

2: See Appendix A for details.

Table 3-2
Air Samples Collected by Teck Cominco on May 18, 2006 at 9:00 AM: Summary of Analytical Results (CANTEST)

Sample ID		S#1	S#2	S#3	S#4	S#5	
Location	Units	Bottom of Pit	Upstream in Pipe (at Bottom of Pit)	3900 Portal Sump	961/962	Gerry Soron	Typical Ambient Air[1]
Oxygen (O_2)	% (v/v)	4	3	20	20	20	20.946
Nitrogen (N_2)	% (v/v)	90	90	78	78	78	78.084
Carbon dioxide (CO_2)	% (v/v)	6	6	0.0611	0.0498	0.219	0.035
Carbon monoxide (CO)	ppm (v/v)	<1	<1	<1	<1	<1	-
Methane (CH_4)	ppm (v/v)	10.6	1680	2.2	<2	2.1	1.7
Nitrous Oxide (N_2O)	ppm (v/v)	11.5	11.6	0.4	0.4	1.3	<0.5
Total Hydrocarbon	ppm (v/v)	41.6	1720	23.7	15.9	9.2	-
Sulphur dioxide (SO_2)	ppm (v/v)	<0.1	<0.1	<0.1	<0.1	<0.1	-
Hydrogen Sulphide (H_2S)	ppm (v/v)	<0.5	<0.5	<0.5	<0.5	<0.5	-
Volatile Organic Compounds (VOCs)[2]	ppm (v/v)	All 39 species included in the analysis were below detection limit in all samples.					

Notes:
<: indicates concentrations less than stated detection limit.
1: Source: CRC Handbook of Chemistry and Physics and NASA Earth Fact Sheet: http://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html.
2: See Appendix B for details.

Table 3-3
Air Samples Collected by Ministry of Energy and Mines on May 19, 2006 at 1:07 AM: Summary of Analytical Results (ALS)

Sample ID		1A/B	2A/B	3A/B	Clean Air 1/2	
Location	**Units**	**Pipe Air**	**1 Foot Below Grade (in Pit)**	**5 Feet Above Grade (Inside Shed)**	**Fresh Air**	**Typical Ambient Air[1]**
Oxygen (O_2)	% (v/v)	2	2	18	21	20.946
Nitrogen (N_2)	% (v/v)	92	91	80	78	78.084
Carbon dioxide (CO_2)	% (v/v)	5.9	5.7	1	0.049	0.035
Carbon monoxide (CO)	ppm (v/v)	<1	<1	<1	<1	-
Methane (CH_4)	ppm (v/v)	n/a	n/a	n/a	n/a	1.7
Nitrous Oxide (N_2O)	ppm (v/v)	n/a	n/a	n/a	n/a	<0.5
Total Hydrocarbon	ppm (v/v)	n/a	n/a	n/a	n/a	-
Sulphur dioxide (SO_2)	ppm (v/v)	n/a	n/a	n/a	n/a	-
Hydrogen Sulphide (H_2S)	ppb (v/v)	<10	<10	<10	<10	-
Volatile Organic Compounds (VOCs)[2]	$\mu g/m^3$	21	550	400	330	-

Notes:
<: indicates concentrations less than stated detection limit.
1: Source: CRC Handbook of Chemistry and Physics and NASA Earth Fact Sheet: http://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html.
2: See Appendix C for details.

the door to the shed had been opened for approximately 30 minutes. A sample collected five feet above grade in the shed on the night of May 18, 2006 by BC MEM contained 18% oxygen, 80% nitrogen and 1% carbon dioxide.

The composition of the air quality samples collected by Rescan on May 20, 2006, from the sump of the 3900 level portal was nearly identical to the composition of ambient air with slightly elevated carbon dioxide concentrations. This result was comparable to a sample collected at the same location by Teck Cominco on the morning of May 18, 2006 (Table 3-2).

3.2 Water Quality

The results of the on-site measurements of temperature, pH and dissolved oxygen of the waste rock seepage in the sump were:

- temperature: 9.0 to 9.1°C
- pH: 3.3
- dissolved oxygen: 0.0 %

Results of the water quality analysis were supplied by ALS Environmental Laboratories on May 25, 2006. The results are summarized in Table 3-4. A copy of the original water quality data report is included in Appendix B.

Table 3-4
Sump Water: Analytical Results

Sample ID		1A	1B	Travel Blank
Date Sampled		5/20/2006	5/20/2006	n/a
Time Sampled	Units	8:20	8:25	n/a
Physical Tests				
Colour	CU	75.7	73.7	<5.0
Conductivity	uS/cm	16000	15900	<2.0
Total Dissolved Solids	mg/L	30800	34300	<10
Hardness	mg/L	8070	8030	<0.54
pH	pH	3.27	3.27	5.89
Total Suspended Solids	mg/L	21.1	44.4	<3.0
Turbidity	NTU	7.82	6.75	<0.10
Dissolved Anions				
Acidity (to pH 8.3)	mg/L	11300	11600	1.8
Alkalinity-Total	mg/L	<2.0	<2.0	<2.0
Bromide	mg/L	<0.50	<0.50	<0.050
Chloride	mg/L	40.5	40.5	<0.50
Fluoride	mg/L	18.5	20.8	<0.020
Sulphate	mg/L	19500	18900	<0.50

(continued)

Table 3-4
Sump Water: Analytical Results (continued)

Sample ID		1A	1B	Travel Blank
Date Sampled		**5/20/2006**	**5/20/2006**	**n/a**
Time Sampled	**Units**	**8:20**	**8:25**	**n/a**
Nutrients				
Ammonia Nitrogen	mg/L	6.26	5.05	<0.0050
Total Kjeldahl Nitrogen	mg/L	6.05	6.24	<0.050
Nitrate Nitrogen	mg/L	31.4	31.2	<0.0050
Nitrite Nitrogen	mg/L	0.046	0.030	<0.0010
Total Nitrogen	mg/L	43.2	44.6	<0.050
Total Phosphate	mg/L	0.0633	0.0673	<0.0020
Cyanides				
Total Cyanide	mg/L	0.0013	<0.0010	n/a
Total Metals				
Total Aluminum	mg/L	843	875	<0.0010
Total Antimony	mg/L	<0.10	<0.10	<0.00010
Total Arsenic	mg/L	<0.10	<0.10	<0.00010
Total Barium	mg/L	<0.050	<0.050	<0.000050
Total Beryllium	mg/L	<0.50	<0.50	<0.00050
Total Bismuth	mg/L	<0.50	<0.50	<0.00050
Total Boron	mg/L	<10	<10	<0.010
Total Cadmium	mg/L	2.98	3.09	<0.000050
Total Calcium	mg/L	442	442	<0.050
Total Chromium	mg/L	<0.50	<0.50	<0.00050
Total Cobalt	mg/L	2.22	2.30	<0.00010
Total Copper	mg/L	1.83	1.87	<0.00010
Total Iron	mg/L	122	121	<0.030
Total Lead	mg/L	0.292	0.286	<0.000050
Total Lithium	mg/L	<5.0	<5.0	<0.0050
Total Magnesium	mg/L	1670	1670	<0.10
Total Manganese	mg/L	673	712	<0.000050
Total Mercury	mg/L	0.000268	0.000167	<0.000050
Total Molybdenum	mg/L	<0.050	<0.050	<0.000050
Total Nickel	mg/L	4.25	4.44	<0.00050
Total Phosphorus	mg/L	<3.0	<3.0	<0.30
Total Potassium	mg/L	30	30	<2.0
Total Selenium	mg/L	<1.0	<1.0	<0.0010
Total Silicon	mg/L	33.6	33.5	<0.050
Total Silver	mg/L	<0.010	<0.010	<0.000010
Total Sodium	mg/L	35	35	<2.0

(continued)

Table 3-4
Sump Water: Analytical Results (continued)

Sample ID		1A	1B	Travel Blank
Date Sampled		5/20/2006	5/20/2006	n/a
Time Sampled	Units	8:20	8:25	n/a
Total Metals (cont'd)				
Total Strontium	mg/L	1.39	1.44	<0.00010
Total Thallium	mg/L	<0.10	<0.10	<0.00010
Total Tin	mg/L	<0.10	<0.10	<0.00010
Total Titanium	mg/L	<0.10	<0.10	<0.010
Total Uranium	mg/L	0.171	0.177	<0.000010
Total Vanadium	mg/L	<1.0	<1.0	<0.0010
Total Zinc	mg/L	4140	4320	<0.0010
Dissolved Metals				
Diss. Aluminum	mg/L	838	848	n/a
Diss. Antimony	mg/L	<0.10	<0.10	n/a
Diss. Arsenic	mg/L	<0.10	<0.10	n/a
Diss. Barium	mg/L	<0.050	<0.050	n/a
Diss. Beryllium	mg/L	<0.50	<0.50	n/a
Diss. Bismuth	mg/L	<0.50	<0.50	n/a
Diss. Boron	mg/L	<10	<10	n/a
Diss. Cadmium	mg/L	3.05	2.88	n/a
Diss. Calcium	mg/L	440	441	n/a
Diss. Chromium	mg/L	<0.50	<0.50	n/a
Diss. Cobalt	mg/L	2.23	2.27	n/a
Diss. Copper	mg/L	1.94	1.86	n/a
Diss. Iron	mg/L	120	121	n/a
Diss. Lead	mg/L	0.292	0.273	n/a
Diss. Lithium	mg/L	<5.0	<5.0	n/a
Diss. Magnesium	mg/L	1690	1680	n/a
Diss. Manganese	mg/L	676	688	n/a
Diss. Mercury	mg/L	0.000235	0.000205	n/a
Diss. Molybdenum	mg/L	<0.050	<0.050	n/a
Diss. Nickel	mg/L	4.48	4.27	n/a
Diss. Phosphorus	mg/L	<3.0	<3.0	n/a
Diss. Potassium	mg/L	30	30	n/a
Diss. Selenium	mg/L	<1.0	<1.0	n/a
Diss. Silicon	mg/L	33.4	33.5	n/a
Diss. Silver	mg/L	<0.010	<0.010	n/a
Diss. Sodium	mg/L	35	35	n/a
Diss. Strontium	mg/L	1.41	1.39	n/a

(continued)

Table 3-4
Sump Water: Analytical Results (completed)

Sample ID		1A	1B	Travel Blank
Date Sampled		5/20/2006	5/20/2006	n/a
Time Sampled	Units	8:20	8:25	n/a
Dissolved Metals (cont'd)				
Diss. Thallium	mg/L	<0.10	<0.10	n/a
Diss. Tin	mg/L	<0.10	<0.10	n/a
Diss. Titanium	mg/L	<0.10	<0.10	n/a
Diss. Uranium	mg/L	0.176	0.173	n/a
Diss. Vanadium	mg/L	<1.0	<1.0	n/a
Diss. Zinc	mg/L	4190	4200	n/a
Organic Parameters				
Total Organic Carbon	mg/L	19.2	18.7	n/a

Notes:
<: Less than the detection limit indicated.

3.3 Microbial Activity

Table 3-5 shows the results of the microbial analysis of the sump water collected at the site of the Sullivan incident. Appendix C shows a copy of the original data report from IG MicroMed Environmental.

Table 3-5
Results of Microbial Activity Analysis

Sample ID	Date/Time Collected	Heteorotrophic Plate Count (cfu/ml)	Sulphate Reducers	Hydrocarbon Degraders – Diesel Fuel (cfu/ml)
1A	May 20, 2006, 8:10 AM	7	Not seen microscopically	<50
1B	May 20, 2006, 8:10 AM	9	Not seen microscopically	<50

Note:
cfu: colony forming units.

Unfortunately, an analytical test for the bacteria *Thiobacillus ferrooxidans* was not available from IG MicroMed. *Thiobacillus ferrooxidans* is recognized as being responsible for the oxidation of iron and inorganic sulphur compounds in mine tailings where these compounds are abundant (Mousavi *et al.*, 2006).

4. ANALYSIS AND DISCUSSION

4. Analysis and Discussion

4.1 Causes of Incident

The air quality results demonstrated that it was the oxygen-depleted atmosphere in the shed constructed over the bottom drain pipe that was the cause of the fatal incident at the Sullivan Mine. The oxygen content inside the shed and in the bottom of the pit was 2%, while carbon dioxide levels were measured at 7% (Table 3-1). Exposure to an atmosphere that contains less than 6% oxygen leads to immediate loss of consciousness without warning signs and subsequent death by asphyxiation (EIGA, 2003).

The measured concentrations of carbon dioxide of 7% would not have been immediately fatal but would have caused drowsiness, heavy breathing, dizziness and narcotic effects, had levels of oxygen been normal. Hydrogen sulphide, carbon monoxide and methane concentrations were all far below detrimental exposure limits (Doss and Person, 2002).

Confined spaces are potentially hazardous and should be treated with caution. Manure pits are the most common scene of asphyxiation fatalities in confined spaces. Manure pits contain high levels of decomposing organic material, which consume oxygen and produce noxious gasses such as hydrogen sulphide, ammonia and carbon monoxide. Methane gas can also be produced as a result of anaerobic bacterial decomposition of organic matter. While methane has relatively low toxicity, it is an explosive hazard at higher concentrations and can displace oxygen (NIOSH, 1990).

The microbial tests showed negligible heterotrophic bacterial activity, which indicate very low levels of aerobic decomposition of organic material (see Table 3-3). However, slightly elevated concentrations of methane gas suggest some anaerobic microbial activity (methanogens). Hydrocarbon degrading bacteria or sulphate reducing bacteria were not detected, which indicate that the oxygen depletion was not caused by degradation of possible hydrocarbon buried with the waste rock.

The oxygen depletion of the air at the sampling station where the incident took place was most likely caused by geochemical reactions within the waste rock pile connected to the sampling station. The waste rock produced by the Sullivan Mine contains sulphides, such as pyrite and pyritite, which oxidize and produce ARD through a series of chemical reactions. The water draining from the waste rock pile is typical of ARD: low pH (3.3), low (or no) dissolved oxygen, high levels of dissolved mineral and metal species including sulphate, aluminium, calcium, cadmium, cobalt, iron, magnesium, manganese, nickel and zinc (see Table 3-4). The low levels of nitrate and ammonia contained in the water are possibly remnants of explosives residues.

The strategy for curbing ARD is to prevent oxygen from entering the waste rock pile, thus reducing the rate of sulphide oxidation. This is typically done by submerging sulphide-bearing waste rock underwater or by attempting to reduce the ingress of air by placing a topsoil cover on the waste rock pile. Recent reclamation efforts by Teck Cominco included the placement of a thick layer (1 to 1.5 m) of topsoil over the waste rock pile. The topsoil cover extended past a

French drain along the base of the waste rock pile in an effort to seal off possible conduits from the drain to the waste rock pile.

Although a topsoil cover reduces oxygen transfer to a waste rock pile, it does not create a perfect seal. Air can diffuse through the soil and flow through cracks and openings in the cover, like culverts and drainage ditches. As oxygen enters the waste rock pile, pyrite or pyritite will oxidize through the chemical reactions described below (Stumm and Morgan, 1995):

Oxidation of pyrite:

$$FeS_2 + 3.5\ O_2 + H_2O \rightarrow Fe^{2+} + 2\ SO_4^{2-} + 2\ H^+ \quad (1)$$

The resulting Fe^{2+} in reaction (1) can be oxidized to Fe^{2+} by:

$$2\ Fe^{2+} + 0.5\ O_2 + 2\ H^+ \rightarrow 2\ Fe^{3+} + H_2O \quad (2)$$

The conversion of Fe(II) to Fe(III) can be greatly accelerated by the bacteria species *Thiobacillus ferroxidans*. These bacteria and several other species thought to be involved in pyrite oxidation are widespread in the environment. *T. ferroxidans* has been shown to increase the iron conversion reaction rate by a factor of hundreds to as much as one million times (Nordstrom and Southam, 1997; Bachelar-Nicolau and Johnson, 1998).

Combining reactions (1) and (2) gives:

$$2\ FeS_2 + 7.5\ O_2 + H_2O \rightarrow 2\ Fe^{3+} + 4\ SO_4^{2-} + 2\ H^+ \quad (3)$$

In a solution with pH>3, Fe(III) can precipitate from solution to produce additional acid (Janzen *et al.*, 2000):

$$Fe^{3+} + 3\ H_2O \rightarrow Fe(OH)_3 + 3\ H^+ \quad (4)$$

Alternatively, Fe(III) can be consumed through further oxidation of sulphide minerals in acidic water by (Lee *et al.*, 2003):

$$FeS_2 + 14\ Fe^{3+} + 8\ H_2O \rightarrow 15\ Fe^{3+} + 2\ SO_4^{2-} + 16\ H^+ \quad (5)$$

Lee *et al.* (2003) showed that the acid generated by pyrite oxidation can dissolve available carbonates commonly found in waste rock to produce CO_2 gas by the following neutralizing reaction:

$$CO_3^{2-} + 2\ H^+ \rightarrow H_2O + CO_2 \quad (6)$$

Combining reactions (1) and (6) yields:

$$FeS_2 + 3.5\ O_2 + CO_3^{2-} \rightarrow Fe^{2+} + 2\ SO_4^{2-} + CO_2 \quad (7)$$

In addition, combining reactions (3) and (6) yields Eq. (10):

$$2\ FeS_2 + 7.5\ O_2 + CaCO_3 \rightarrow 2\ Fe^{3+} + Ca^{2+} + 4\ SO_4^{2-} + CO_2 \quad (8)$$

According to Lee *et al* (2003), consumption of 1 mol of O_2 by pyrite oxidation with carbonate neutralization may produce between 0.1 and 0.5 mol of CO_2 and between 0.5 and 0.6 mol of sulphate. Reactions associated with microbial degradation of organic material produced 0.5 to 0.7 mol of CO_2 for 1 mol of oxygen consumed. The composition of the air leaving the waste

rock pile at the site of the Sullivan incident was 2% O_2, 7% CO_2 and 90% N_2. Thus, approximately 0.4 mol CO_2 were produced for every 1 mol of O_2 consumed.

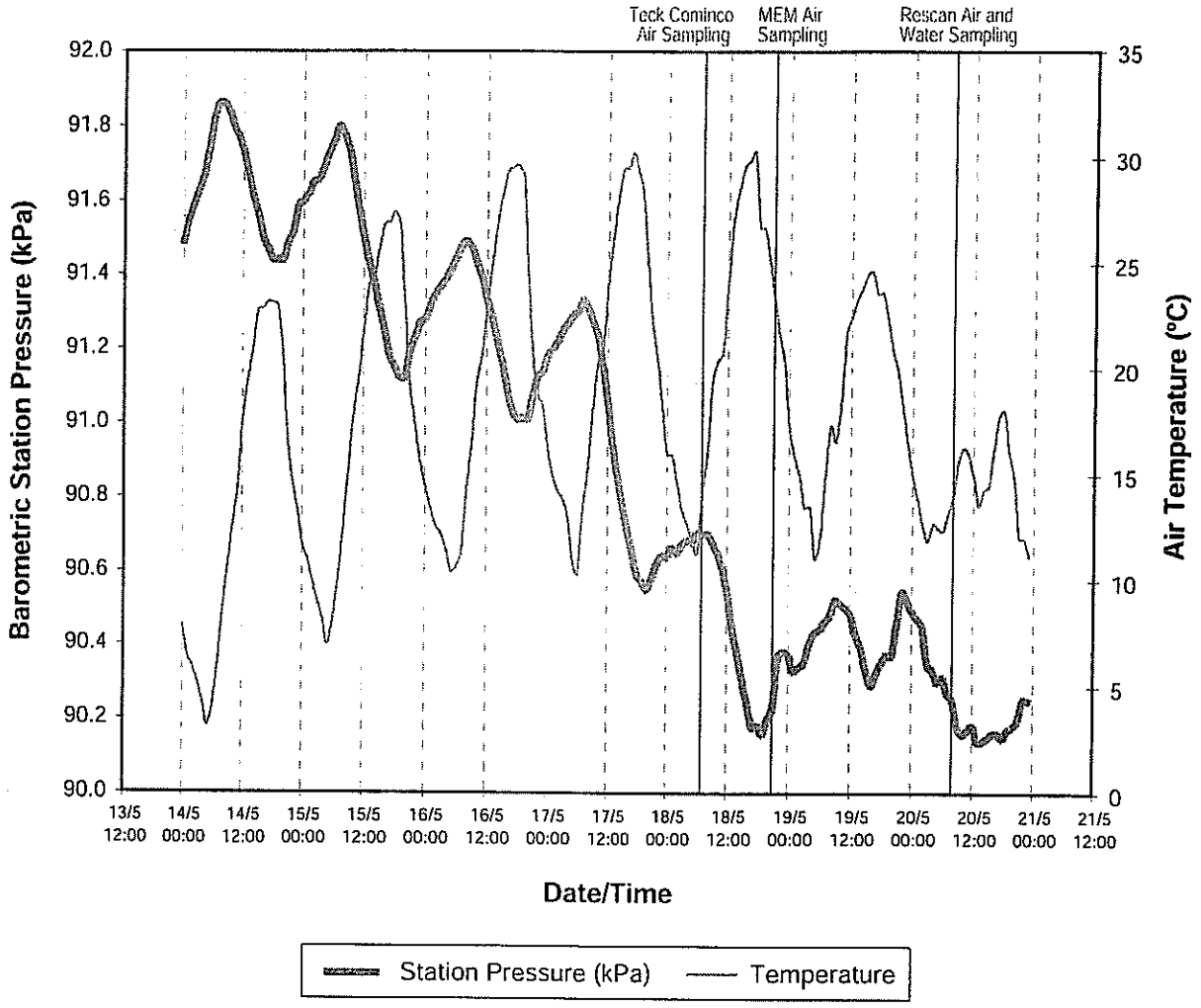
There are several gas transfer mechanism involved in the exchange of gasses between a waste rock pile and the surrounding environment including diffusion, convection and advection:

- As air enters the waste rock pile and sulphide is oxidized, an oxygen concentration gradient is established between the waste rock pile interior and the ambient air. This gradient provides a driving force for diffusion.
- The sulphide oxidation reaction is exothermic (heat-producing). Therefore, if the sulphide oxidation rate is sufficiently high, the temperature of the air inside the waste rock will increase and air may rise (convection) through the waste rock pile (Sraceka *et al.*, 2004).
- At moderate or low sulphide oxidation rates, the production of heat within the waste rock pile may not be sufficient for convection to take place. As oxygen is replaced by heavier carbon dioxide, the density of the air increases and the air will tend to sink (gravity driven advection). If the temperature inside the waste rock pile is lower than the ambient air, the cooler air inside the waste rock pile will be denser than ambient air and will flow towards openings down-gradient. In addition, atmospheric pressure gradients may drive advection; blowing winds or rising and falling barometric pressure may increase gas transfer between the waste rock pile and the ambient air.

The mechanism that caused the oxygen-depleted air to flow from the waste rock pile to the sampling shed at the Sullivan Mine was likely density and temperature/pressure driven advection. The ambient temperature was measured at 14°C, while the air flowing from the waste rock pile was 8.9°C. The sulphide oxidation reactions would have depleted oxygen from air entering the waste rock pile, while the neutralization reactions would have added carbon dioxide to the air. Inside the pile, the oxygen-depleted air would have cooled and flowed along channels in the waste rock down-gradient toward openings such as the pipe located below the sampling shed.

Records of barometric pressure and air temperature are not available for Kimberly for May 2006. However, barometric pressure measured and recorded hourly at Cranbrook Airport, located approximately 30 km southeast of Kimberly was available. Figure 4-1 shows hourly barometric pressure and air temperature at Cranbrook Airport between May 14 and 21, 2006.

From May 14 to May 19, there were distinct diurnal fluctuations in temperature and barometric pressure, with an overall trend of decreasing barometric pressure and increasing temperature. Starting at approximately 8:00 AM, the air temperature would start to increase, causing the barometric pressure to drop. This trend would last until sunset – between 7:00 PM and 8:00 PM – when the trend would slowly reverse (decreasing air temperature and increasing pressure). This hypothesis is supported by the airflow measurements taken in the pipe from the rock pile. The flows in the pipe in the evening were approximately double the flows in the morning. The ambient temperature during the daytime hours was generally well above the temperature of the air flowing from the waste rock pile (9°C).



Hourly Temperature and Barometric Pressure at Cranbrook Airport, May 14 to 21, 2006

FIGURE 4-1

BRITISH COLUMBIA

Rescan™

4.2 Prevention of Future Incidents

While identification of a confined space often is obvious with 20/20 hindsight, it is very unlikely that workers of any profession who have not completed confined space training and who are not regularly exposed to confined spaces would have recognized the danger. As environmental consultants, Rescan scientists and engineers collect thousands of water samples every year, mostly from groundwater wells and in open lakes, creeks and rivers, but also from open waste rock and tailings impoundments, culverts and ditches. Rescan staff is therefore included in the category of workers that would have been very unlikely to recognize the fatal danger that was present at the Sullivan site.

The widely published accounts of the Sullivan tragedy have helped to increase awareness of the very real hazards associated with working in and around confined spaces. Future efforts should be focused on strengthening awareness and enforcement of section 3.4 of the *Health, Safety and Reclamation Code for Mines in British Columbia* (BC MEM, 2003). For example, confined space training could be mandatory for any employee or contractor working at active or decommissioned mine sites. The existing regulations provide clear guidelines for appropriate working procedures.

However, identification of confined spaces may not be sufficient to prevent future incidents. Whether or not it flows into a confined space, any culvert or large pipe with an appreciable outflow of oxygen-depleted air constitutes a hazard. As has been stated, a second breath of air with less than 6% oxygen will cause immediate loss of consciousness and death (EIGA, 2003). An unwitting person looking into a pipe, culvert or other vent that is discharging oxygen-depleted air could succumb to asphyxiation in a few seconds. Therefore, special attention must be paid to any openings that allow for air transfer between a covered reactive waste rock pile and the ambient air. A safe perimeter around the openings should be fenced off and warnings should be clearly posted. Established procedures for working in and around confined spaces should be followed when accessing such sites.

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APPENDIX A
CANTEST AIR QUALITY ANALYSIS REPORT
(RESCAN MAY 20, 2006)

Analysis Report

CANTEST

CANTEST LTD.
Professional
Analytical
Services

4606 Canada Way
Burnaby, B.C.
V5G 1K5

Fax: 604 731 2386

Tel: 604 734 7276

1 800 665 8566

REPORT ON: Amended Report - Analysis of Gas Samples

REPORTED TO: Rescan Environmental Services Ltd.
6th Flr-1111 West Hastings St
Vancouver, BC
V6E 2J3

Att'n:

CHAIN OF CUSTODY: 196837
PROJECT NAME: MOEM
PROJECT NUMBER: 246-0

NUMBER OF SAMPLES: 8

REPORT DATE: May 26, 2006

DATE SUBMITTED: May 23, 2006

GROUP NUMBER: 70523009

SAMPLE TYPE: Gas

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Carbon Monoxide in Gas - analysis was performed using procedures based on WCB Method 4200 using gas chromatography with methanization and flame ionization detection.

Carbon Dioxide in Gas - analysis was performed using procedures based on WCB Method 4100 using gas chromatography with methanization and flame ionization detection.

Carbon Dioxide in Gas - analysis was performed using a gas chromatograph with thermal conductivity detection.

Methane in Gas - analysis was performed using gas chromatography with flame ionization detection.

Nitrogen in Gas - analysis was performed using a gas chromatograph with thermal conductivity detection.

Nitrous Oxide in Gas and Air - analysis was performed using procedures based on WCB Method 1101, involving analysis using gas chromatography with electron capture detection.

Oxygen in Gas - analysis was performed using a gas chromatograph with thermal conductivity detection.

Hydrogen sulphide in Air - analysis was based on WCB Method 0810. Hydrogen sulphide concentration is determined by drawing a known volume of air through a long-term colour indicating tube. The length of colour change in the tube is used to determine the concentration.

(Continued)

CANTEST LTD.

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

Sulphur Dioxide in Air - analysis was based on WCB Method 1360. Sulphur dioxide concentration was determined by drawing a known volume of air through a long-term detector tube. The length of colour change in the tube is used to determine the sulphur dioxide concentration.

Total Hydrocarbons in Gas - analysis was performed using procedures based on WCB Method 4700 using gas chromatography with flame ionization detection.

Volatile Organic Compounds in Gaseous Samples - analysis was performed using a modification of U.S. EPA Methods 624/8240/8260, involving injection of a gas sample into a Purge and Trap apparatus and analysis using GC/MS.

COMMENTS:

Amended Report: This report supersedes the electronic report issued on May 24, 2006. Samples 1B and 2B is omitted as requested by the client. No other chromatographable organic compounds were detected and identified in the submitted air samples.

TEST RESULTS:

(See following pages)

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

CANTEST

Total Hydrocarbons in Gas

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Total Hydrocarbons
1A	May 20/06	605230026	10.8
2A	May 20/06	605230031	8.1
3A	May 20/06	605230033	< 2
3B	May 20/06	605230035	< 2
BAG1	May 20/06	605230036	< 2
BAG2	May 20/06	605230037	< 2
TOPA	May 20/06	605230038	8.4
TOPB	May 20/06	605230039	5.6
DETECTION LIMIT			2
UNITS			mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v)
< = Less than detection limit

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

CANTEST

Compounds Determined using Detector Tubes in Gas

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Sulphur Dioxide SO2	Hydrogen sulphide H2S
1A	May 20/06	605230026	<	<
2A	May 20/06	605230031	<	<
3A	May 20/06	605230033	<	<
3B	May 20/06	605230035	<	<
BAG1	May 20/06	605230036	<	<
BAG2	May 20/06	605230037	<	<
TOPA	May 20/06	605230038	<	<
TOPB	May 20/06	605230039	<	<
DETECTION LIMIT			0.1	0.5
UNITS			mL/cu. m	mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v)
< = Less than detection limit

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

CANTEST

Volatile Organic Compounds in Gas

CLIENT SAMPLE IDENTIFICATION:	1A	2A	3A	3B	DETECTION LIMIT
DATE SAMPLED:	May 20/06	May 20/06	May 20/06	May 20/06	
CANTEST ID:	605230026	605230031	605230033	605230035	
ANALYSIS DATE:	May 23/06	May 24/6	May 24/6	May 23/06	
Benzene	<	<	<	<	0.01
Bromodichloromethane	<	<	<	<	0.01
Bromoform	<	<	<	<	0.02
Bromomethane	<	<	<	<	0.08
2-Butanone	<	<	<	<	0.5
Carbon Tetrachloride	<	<	<	<	0.01
Chlorobenzene	<	<	<	<	0.01
Chloroethane	<	<	<	<	0.04
Chloroform	<	<	<	<	0.03
Chloromethane	<	<	<	<	0.04
Dibromochloromethane	<	<	<	<	0.01
1,2-Dibromoethane	<	<	<	<	0.01
Dibromomethane	<	<	<	<	0.02
Dichlorodifluoromethane	<	<	<	<	0.02
1,2-Dichlorobenzene	<	<	<	<	0.01
1,3-Dichlorobenzene	<	<	<	<	0.01
1,4-Dichlorobenzene	<	<	<	<	0.01
1,1-Dichloroethane	<	<	<	<	0.01
1,2-Dichloroethane	<	<	<	<	0.04
1,1-Dichloroethene	<	<	<	<	0.01
cis-1,2-Dichloroethene	<	<	<	<	0.01
trans-1,2-Dichloroethene	<	<	<	<	0.01
1,2-Dichloropropane	<	<	<	<	0.01
cis-1,3-Dichloropropene	<	<	<	<	0.01
trans-1,3-Dichloropropene	<	<	<	<	0.01
Ethylbenzene	<	<	<	<	0.01
2-Hexanone	<	<	<	<	0.5
4-Methyl-2-pentanone	<	<	<	<	0.2
Methylene Chloride	<	<	<	<	0.6
Styrene	<	<	<	<	0.01
1,1,2,2-Tetrachloroethane	<	<	<	<	0.02

(Continued on next page)

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

CANTEST

Volatile Organic Compounds in Gas

CLIENT SAMPLE IDENTIFICATION:	1A	2A	3A	3B	DETECTION LIMIT
DATE SAMPLED:	May 20/06	May 20/06	May 20/06	May 20/06	
CANTEST ID:	605230026	605230031	605230033	605230035	
ANALYSIS DATE:	May 23/06	May 24/6	May 24/6	May 23/06	
Tetrachloroethene	<	<	<	<	0.01
Toluene	<	<	<	<	0.01
1,1,1-Trichloroethane	<	<	<	<	0.01
1,1,2-Trichloroethane	<	<	<	<	0.01
Trichloroethene	<	<	<	<	0.01
Trichlorofluoromethane	<	<	<	<	0.005
Vinyl Chloride	<	<	<	<	0.02
Xylenes	<	<	<	<	0.01

sults expressed as milligrams per cubic meter (mg/cu. m)
= Less than detection limit

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

CANTEST

Volatile Organic Compounds in Gas

CLIENT SAMPLE IDENTIFICATION:	BAG1	BAG2	TOPA	TOPB	DETECTION LIMIT
DATE SAMPLED:	May 20/06	May 20/06	May 20/06	May 20/06	
CANTEST ID:	605230036	605230037	605230038	605230039	
ANALYSIS DATE:	May 23/06	May 23/06	May 23/06	May 23/06	
Benzene	<	<	<	<	0.01
Bromodichloromethane	<	<	<	<	0.01
Bromoform	<	<	<	<	0.02
Bromomethane	<	<	<	<	0.08
2-Butanone	<	<	<	<	0.5
Carbon Tetrachloride	<	<	<	<	0.01
Chlorobenzene	<	<	<	<	0.01
Chloroethane	<	<	<	<	0.04
Chloroform	<	<	<	<	0.03
Chloromethane	<	<	<	<	0.04
Dibromochloromethane	<	<	<	<	0.01
1,2-Dibromoethane	<	<	<	<	0.01
Dibromomethane	<	<	<	<	0.02
Dichlorodifluoromethane	<	<	<	<	0.02
1,2-Dichlorobenzene	<	<	<	<	0.01
1,3-Dichlorobenzene	<	<	<	<	0.01
1,4-Dichlorobenzene	<	<	<	<	0.01
1,1-Dichloroethane	<	<	<	<	0.01
1,2-Dichloroethane	<	<	<	<	0.04
1,1-Dichloroethene	<	<	<	<	0.01
cis-1,2-Dichloroethene	<	<	<	<	0.01
trans-1,2-Dichloroethene	<	<	<	<	0.01
1,2-Dichloropropane	<	<	<	<	0.01
cis-1,3-Dichloropropene	<	<	<	<	0.01
trans-1,3-Dichloropropene	<	<	<	<	0.01
Ethylbenzene	<	<	<	<	0.01
2-Hexanone	<	<	<	<	0.5
4-Methyl-2-pentanone	<	<	<	<	0.2
Methylene Chloride	<	<	<	<	0.6
Styrene	<	<	<	<	0.01
1,1,2,2-Tetrachloroethane	<	<	<	<	0.02

(Continued on next page)

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

CANTEST

Volatile Organic Compounds in Gas

CLIENT SAMPLE IDENTIFICATION:	BAG1	BAG2	TOPA	TOPB	DETECTION LIMIT
DATE SAMPLED:	May 20/06	May 20/06	May 20/06	May 20/06	
CANTEST ID:	605230036	605230037	605230038	605230039	
ANALYSIS DATE:	May 23/06	May 23/06	May 23/06	May 23/06	
Tetrachloroethene	<	<	<	<	0.01
Toluene	<	<	<	<	0.01
1,1,1-Trichloroethane	<	<	<	<	0.01
1,1,2-Trichloroethane	<	<	<	<	0.01
Trichloroethene	<	<	<	<	0.01
Trichlorofluoromethane	<	<	<	<	0.005
Vinyl Chloride	<	<	<	<	0.02
Xylenes	<	<	<	<	0.01

ults expressed as milligrams per cubic meter (mg/cu. m)
- Less than detection limit

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

CANTEST

Analysis of Components in Gas

CLIENT SAMPLE IDENTIFICATION:	1A	2A	3A	3B	DETECTION LIMIT	UNITS
DATE SAMPLED:	May 20/06	May 20/06	May 20/06	May 20/06		
CANTEST ID:	605230026	605230031	605230033	605230035		
Methane	10.8	8.1	<	<	2	mL/cu. m
Carbon Monoxide	<	<	<	<	1	mL/cu. m
Carbon Dioxide	-	-	2570	2840	20	mL/cu. m
Carbon Dioxide	7	7	-	-	1	% by vol.
Oxygen	2	2	19	20	1	% by vol.
Nitrogen	91	90	79	78	1	% by vol.
Nitrous Oxide	12.4	12.7	0.98	0.95	0.3	mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v)
< = Less than detection limit

% by vol. = percent by volume

REPORTED TO: Rescan Environmental Services Ltd.

REPORT DATE: May 26, 2006

GROUP NUMBER: 70523009

CANTEST

Analysis of Components in Gas

CLIENT SAMPLE IDENTIFICATION:	BAG1	BAG2	TOPA	TOPB		
DATE SAMPLED:	May 20/06	May 20/06	May 20/06	May 20/06		
CANTEST ID:	605230036	605230037	605230038	605230039	DETECTION LIMIT	UNITS
Methane	<	<	8.4	5.6	2	mL/cu. m
Carbon Monoxide	<	<	<	<	1	mL/cu. m
Carbon Dioxide	502	532	-	-	20	mL/cu. m
Carbon Dioxide	-	-	3	3	1	% by vol.
Oxygen	20	20	13	12	1	% by vol.
Nitrogen	78	79	83	83	1	% by vol.
Nitrous Oxide	0.4	0.4	6.2	6.7	0.3	mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v) % by vol. = percent by volume
< = Less than detection limit

CAN

DEPARTMENT INTERNAL C. IN of CUSTODY FORM

FOR LEGAL SAMPLES

CoC NUMBER: 196837

Page: 1 of 1

Legal Sample Container ID: _____

NOTE: An internal chain of custody must accompany all legal samples (and aliquots or extracts). If samples are to be "split" into two or more aliquots that may be submitted to two or more separate departments for analysis, a copy of this internal chain of custody is to be made. The copy must accompany the sample aliquots into each of the departments where the analysis will be performed.

Project Manager: _____ Group Number: _____

Department Legal Sample Representative: _____ Number of Samples: 10

Backup: _____ _____ Number of Containers: 10 TEDLAR BAGS

Date	Time	In Custody of (Signature)	Sample ID & Description (see Notes below)	Action (see Notes below)	Date	Time	Returned to Secure Storage (Signature)	Comments
23/5/06	9:28		OS	TX	May 23/06	9:50		
23/5/06	10:30		OS	TX	May 23/06	12:00		
23/5/06	12:00		OS	IA	May 23/06	12:20		
23/5/06	1:00		OS	TX	May 23/06	1:00		
23/05/06	21:00		OS	ST	May 23/06	21:00		
24/05/06	7:30		OS	IA	May 23/06	10:00		
May 24/06	12:30		OS		May 24/06			
May 25/06	5:30		OS	Count samples				
JUNE 19/06	12:36		OS	TX				
June 2/06	13:27		OS	TX				

Notes:
1. Each transfer to Secure Storage must be recorded.
2. Transfer of custody between personnel may be indirect, that is through Secure Storage.
3. The original sample container must be retained, even if empty.
4. Secure Storage may be security tape.

Sample Description:
- OS Original Sample
- SF Split Fraction of Sample
- PS Prepared Sample
- IE In-progress Extract
- AE Final Analysis Extract
- SC Sample Container (Empty)

Actions:
- ST Place into Locked or Secure Storage
- TX Transfer Custody
- SS Split Sample into Fractions
- SP Sample Preparation
- SX Sample Extraction
- IA Instrumental Analysis

Return this form to the Project Manager once all the analyses are completed.

Revision:00
Revision Date: April 19, 2005
Document Control Number: 60-F-028B

CHAIN OF CUSTODY RECORD

CANTEST
4606 Canada Way
Burnaby, B.C.
V5G 1K5

Tel: 604.734.7276
Fax: 604.731.2386
Toll Free: 800.665.8566

www.cantest.com

196837

Client Name: (RESCOL) Rescan Environm. Services Ltd.
Postal Code: V6E 2J3
Page: 1

Street Address (including suite number): 6th Floor - 1111 West Hastings street
City: Vancouver, BC

Telephone: 604 689 9460
Fax: 604 687 4277
E-Mail Address (Required for Electronic Reporting): [illegible] @rescan.com

Contact Name:
Sampler's Name:

Quotation Number:
Project Number: 246-0
Project Name: MOEM
P.O. Number:

RESULTS REQUESTED BY: 24 (Day) 05 (Month) 06 (Year)
100% S/C. N/F MEL
(Surcharges May Apply)

Special Instructions: ☐ AutoFax ☐ AutoEmail
☐ Return Cooler ☐ Ship Containers (please specify)

~~LEGAL SAMPLES~~ MD [illegible]

Sample(s) are from a Drinking Water source servicing multiple households — Yes ☐

Group Number	Sample Identification	Date/Time Sampled (D/M/Y & 24 hr. clock)	Sample Type	Total Metals*	Dissolved Metals*	Field Filtered Metals*	Soil Metals*	pH	Conductivity	BOD	TDS	Alkalinity (total / spec.)	TSS	COD	Coliform - Total & Fecal	E.coli	F Cl SO_4 NO_3	Nitrite	Oil & Grease (Total / HC)	PCP (Tri, Tetra and Penta)	PCP (Mono and Di)	BETX/VPH	VOC	EPH (not PAH corrected)	PAH	LEPH/HEPH (PAH corrected)	PCB	Asbestos	VOC, CH_4, CO, CO_2, H_2, N_2, O_2	SO_2, TOC, H_2S, N_2O	~~TH~~ OG May 23/06		Hold - Do Not Analyze	Number of Containers
70523004																																		
60523004	1A	D: 20/05/06 T: 8:35AM	Air/Gas																										✓	✓	✓ [illegible]			
029	1B	D: 20/05/06 T: 8:38AM	Air/Gas																										✓	✓				
031	2A	D: 20/05/06 T: 8:44AM	Air/Gas																										✓	✓				
032	2B	D: 20/05/06 T: 8:48AM	Air/Gas																										✓	✓				
033	3A	D: 20/05/06 T: 8:58AM	Air/Gas																										✓	✓				
035	3B	D: 20/05/06 T: 9:08AM	Air/Gas																										✓	✓				
036	BAG 1	D: 20/05/06 T: 10:30AM	Air/Gas																										✓	✓				
037	BAG 2	D: 20/05/06 T: 10:34AM	Air/Gas																										✓	✓				
038	TOP A	D: 20/05/06 T: 8:10AM	Air/Gas																										✓	✓				
039	TOP B	D: 20/05/06 T: 8:14AM	Air/Gas																										✓	✓				

Relinquished by: — Date: 23/5/06 Time: 9:29 — Received by:
Relinquished by: — Date: — Time: — Received by:

Total Number of Containers:

Method of Shipment: direct delivery
Waybill No.: –
Received for Lab by: — Date: May 23/06 — Time: 9:35
Shipped by:
Shipment Condition: Ambient temp
Cooler opened by: — Date: — Time:

*Please indicate appropriate regulatory guidelines:

WATER
☐ CCME
☐ BC-CSR
☐ Other (please specify)

SOIL
☐ CCME
☐ BC-CSR
☐ Other (please specify)

FOR LABORATORY USE ONLY
Sample State at Receipt: ☐ Ambient ☐ Cold ☐ Frozen ☑ N/A Comments:
Temperature ____ °C Custody Seal Intact? ☐ Yes ☐ No ☐ n/a Number of Coolers/Shipping Containers: ____

WHITE: FOLLOWS REPORT YELLOW: LAB COPY PINK: CLIENT COPY/GENERAL INFORMATION

APPENDIX B
CANTEST AIR QUALITY ANALYSIS REPORT
(TECK COMINCO, MAY 18, 2006)

Analysis Report

CANTEST LTD.
Professional Analytical Services
4606 Canada Way
Burnaby, B.C.
V5G 1K5
FAX: 604 731 2386
TEL: 604 734 7276
1 800 565 8566

REPORT ON: Analysis of Gas Samples

REPORTED TO: Teck Cominco Ltd.
Kimberley Operations
Bag 2000
Kimberley, BC
V1A 3E1

Att'n: Mr. Bruce Donald

CHAIN OF CUSTODY: 197319

NUMBER OF SAMPLES: 5

REPORT DATE: May 20, 2006

DATE SUBMITTED: May 20, 2006

GROUP NUMBER: 70520001

SAMPLE TYPE: Gas

NOTE: Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

TEST METHODS:

Carbon Monoxide in Gas - analysis was performed using procedures based on WCB Method 4200 using gas chromatography with methanization and flame ionization detection.

Carbon Dioxide in Gas - analysis was performed using procedures based on WCB Method 4100 using gas chromatography with methanization and flame ionization detection.

Carbon Dioxide in Gas - analysis was performed using a gas chromatograph with thermal conductivity detection.

Halogenated Hydrocarbons and Anaesthetic Agents - analysis was performed using procedures described in CSA Z180.1-00. Analysis was performed using gas chromatography with electron capture detection. Target compounds are "Freons", chlorinated-fluorinated ethane and methane compounds, and anaesthetic agents. CANTEST Method reference 67-A-007.

Methane in Gas - analysis was performed using gas chromatography with flame ionization detection.

Nitrogen in Gas - analysis was performed using a gas chromatograph with thermal conductivity detection.

Nitrous Oxide in Gas and Air - analysis was performed using procedures based on WCB Method 1101, involving analysis using gas chromatography with electron capture detection.

Oxygen in Gas - analysis was performed using a gas chromatograph with thermal conductivity detection.

(Continued)

CANTEST LTD.

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

CANTEST

Hydrogen sulphide in Air - analysis was based on WCB Method 0810. Hydrogen sulphide concentration is determined by drawing a known volume of air through a long-term colour indicating tube. The length of colour change in the tube is used to determine the concentration.

Sulphur Dioxide in Air - analysis was based on WCB Method 1360. Sulphur dioxide concentration was determined by drawing a known volume of air through a long-term detector tube. The length of colour change in the tube is used to determine the sulphur dioxide concentration.

Total Hydrocarbons in Gas - analysis was performed using procedures based on WCB Method 4700 using gas chromatography with flame ionization detection.

Volatile Organic Compounds in Gaseous Samples - analysis was performed using a modification of U.S. EPA Methods 624/8240/8260, involving injection of a gas sample into a Purge and Trap apparatus and analysis using GC/MS.

COMMENTS:

No other chromatographable organic compounds were detected and identified in the submitted air samples.

TEST RESULTS:

(See following pages)

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

CANTEST

Total Hydrocarbons in Gas

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Total Hydrocarbons
S#1 Loc'n 1 Bottom of Pit	May 18/06	605200001	41.6
S#2 Loc'n 1 Upstream Pipe	May 18/06	605200002	1720
S#3 Loc'n 2 3900	May 18/06	605200003	23.7
S#4 Loc'n 3 961/962	May 18/06	605200004	15.9
S#5 Loc'n 4 Gerry Soron	May 18/06	605200005	9.2
DETECTION LIMIT			2
UNITS			mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v)

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

CANTEST

Compounds Determined using Detector Tubes in Gas

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Sulphur Dioxide SO2	Hydrogen sulphide H2S
S#1 Loc'n 1 Bottom of Pit	May 18/06	605200001	<	<
S#2 Loc'n 1 Upstream Pipe	May 18/06	605200002	<	<
S#3 Loc'n 2 3900	May 18/06	605200003	<	<
S#4 Loc'n 3 961/962	May 18/06	605200004	<	<
S#5 Loc'n 4 Gerry Soron	May 18/06	605200005	<	<
DETECTION LIMIT			0.1	0.5
UNITS			mL/cu. m	mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v)
< = Less than detection limit

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

CANTEST

Volatile Organic Compounds in Gas

CLIENT SAMPLE IDENTIFICATION:	S#1 Loc'n 1 Bottom of Pit	S#2 Loc'n 1 Upstream Pipe	S#3 Loc'n 2 3900	S#4 Loc'n 3 961/962	
DATE SAMPLED:	May 18/06	May 18/06	May 18/06	May 18/06	
CANTEST ID:	605200001	605200002	605200003	605200004	DETECTION LIMIT
ANALYSIS DATE:	May 20/06	May 20/06	May 20/06	May 20/06	
Benzene	<	<	<	<	0.01
Bromodichloromethane	<	<	<	<	0.01
Bromoform	<	<	<	<	0.02
Bromomethane	<	<	<	<	0.08
2-Butanone	<	<	<	<	0.5
Carbon Tetrachloride	<	<	<	<	0.01
Chlorobenzene	<	<	<	<	0.01
Chloroethane	<	<	<	<	0.04
Chloroform	<	<	<	<	0.03
Chloromethane	<	<	<	<	0.04
Dibromochloromethane	<	<	<	<	0.01
1,2-Dibromoethane	<	<	<	<	0.01
Dibromomethane	<	<	<	<	0.02
Dichlorodifluoromethane	<	<	<	<	0.02
1,2-Dichlorobenzene	<	<	<	<	0.01
1,3-Dichlorobenzene	<	<	<	<	0.01
1,4-Dichlorobenzene	<	<	<	<	0.01
1,1-Dichloroethane	<	<	<	<	0.01
1,2-Dichloroethane	<	<	<	<	0.04
1,1-Dichloroethene	<	<	<	<	0.01
cis-1,2-Dichloroethene	<	<	<	<	0.01
trans-1,2-Dichloroethene	<	<	<	<	0.01
1,2-Dichloropropane	<	<	<	<	0.01
cis-1,3-Dichloropropene	<	<	<	<	0.01
trans-1,3-Dichloropropene	<	<	<	<	0.01
Ethylbenzene	<	<	<	<	0.01
2-Hexanone	<	<	<	<	0.5
4-Methyl-2-pentanone	<	<	<	<	0.2
Methylene Chloride	<	<	<	<	0.6
Styrene	<	<	<	<	0.01
1,1,2,2-Tetrachloroethane	<	<	<	<	0.02

(Continued on next page)

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

CANTEST

Volatile Organic Compounds in Gas

CLIENT SAMPLE IDENTIFICATION:	S#1 Loc'n 1 Bottom of Pit	S#2 Loc'n 1 Upstream Pipe	S#3 Loc'n 2 3900	S#4 Loc'n 3 961/962	
DATE SAMPLED:	May 18/06	May 18/06	May 18/06	May 18/06	
CANTEST ID:	605200001	605200002	605200003	605200004	DETECTION LIMIT
ANALYSIS DATE:	May 20/06	May 20/06	May 20/06	May 20/06	
Tetrachloroethene	<	<	<	<	0.01
Toluene	<	<	<	<	0.01
1,1,1-Trichloroethane	<	<	<	<	0.01
1,1,2-Trichloroethane	<	<	<	<	0.01
Trichloroethene	<	<	<	<	0.01
Trichlorofluoromethane	<	<	<	<	0.005
Vinyl Chloride	<	<	<	<	0.02
Xylenes	<	<	<	<	0.01

Results expressed as milligrams per cubic meter (mg/cu. m)
< = Less than detection limit

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

CANTEST

Volatile Organic Compounds in Gas

CLIENT SAMPLE IDENTIFICATION:	S#5 Loc'n 4 Gerry Soron	
DATE SAMPLED:	May 18/06	
CANTEST ID:	605200005	DETECTION LIMIT
ANALYSIS DATE:	May 20/06	
Benzene	<	0.01
Bromodichloromethane	<	0.01
Bromoform	<	0.02
Bromomethane	<	0.08
2-Butanone	<	0.5
Carbon Tetrachloride	<	0.01
Chlorobenzene	<	0.01
Chloroethane	<	0.04
Chloroform	<	0.03
Chloromethane	<	0.04
Dibromochloromethane	<	0.01
1,2-Dibromoethane	<	0.01
Dibromomethane	<	0.02
Dichlorodifluoromethane	<	0.02
1,2-Dichlorobenzene	<	0.01
1,3-Dichlorobenzene	<	0.01
1,4-Dichlorobenzene	<	0.01
1,1-Dichloroethane	<	0.01
1,2-Dichloroethane	<	0.04
1,1-Dichloroethene	<	0.01
cis-1,2-Dichloroethene	<	0.01
trans-1,2-Dichloroethene	<	0.01
1,2-Dichloropropane	<	0.01
cis-1,3-Dichloropropene	<	0.01
trans-1,3-Dichloropropene	<	0.01
Ethylbenzene	<	0.01
2-Hexanone	<	0.5
4-Methyl-2-pentanone	<	0.2
Methylene Chloride	<	0.6
Styrene	<	0.01
1,1,2,2-Tetrachloroethane	<	0.02

(Continued on next page)

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

Volatile Organic Compounds in Gas

CLIENT SAMPLE IDENTIFICATION:	S#5 Loc'n 4 Gerry Soran	
DATE SAMPLED:	May 18/06	
CANTEST ID:	605200005	DETECTION LIMIT
ANALYSIS DATE:	May 20/06	
Tetrachloroethene	<	0.01
Toluene	<	0.01
1,1,1-Trichloroethane	<	0.01
1,1,2-Trichloroethane	<	0.01
Trichloroethene	<	0.01
Trichlorofluoromethane	<	0.005
Vinyl Chloride	<	0.02
Xylenes	<	0.01

Results expressed as milligrams per cubic meter (mg/cu. m)
< = Less than detection limit

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

CANTEST

Analysis of Components in Gas

CLIENT SAMPLE IDENTIFICATION:	S#1 Loc'n 1 Bottom of Pit	S#2 Loc'n 1 Upstream Pipe	S#3 Loc'n 2 3900	S#4 Loc'n 3 961/962		
DATE SAMPLED:	May 18/06	May 18/06	May 18/06	May 18/06	DETECTION LIMIT	UNITS
CANTEST ID:	605200001	605200002	605200003	605200004		
Methane	10.6	1680	2.2	<	2	mL/cu. m
Carbon Monoxide	<	<	<	<	1	mL/cu. m
Carbon Dioxide	-	-	611	498	20	mL/cu. m
Carbon Dioxide	6	6	-	-	1	% by vol.
Oxygen	4	3	20	20	1	% by vol.
Nitrogen	90	90	78	78	1	% by vol.
Nitrous Oxide	11.5	11.6	0.4	0.4	0.3	mL/cu. m
Trichlorotrifluoroethane	<	<	<	<	0.1	mL/cu. m
Chlorodifluoromethane	<	<	<	<	0.05	mL/cu. m
Dichlorodifluoromethane	<	<	<	<	0.1	mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v) % by vol. = percent by volume

< = Less than detection limit

REPORTED TO: Teck Cominco Ltd.

REPORT DATE: May 20, 2006

GROUP NUMBER: 70520001

CANTEST

Analysis of Components in Gas

CLIENT SAMPLE IDENTIFICATION:	S#5 Loc'n 4 Gerry Soron		
DATE SAMPLED:	May 18/06	DETECTION LIMIT	UNITS
CANTEST ID:	605200005		
Methane	2.1	2	mL/cu. m
Carbon Monoxide	<	1	mL/cu. m
Carbon Dioxide	2190	20	mL/cu. m
Oxygen	20	1	% by vol.
Nitrogen	78	1	% by vol.
Nitrous Oxide	1.3	0.3	mL/cu. m
Trichlorotrifluoroethane	<	0.1	mL/cu. m
Chlorodifluoromethane	<	0.05	mL/cu. m
Dichlorodifluoromethane	<	0.1	mL/cu. m

mL/cu. m = mL/cubic meter or ppm (v/v) % by vol. = percent by volume
< = Less than detection limit

APPENDIX C
ALS AIR QUALITY ANALYSIS REPORT
(MINISTRY OF ENERGY AND MINES, MAY 18, 2006)

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

PRELIMINARY RESULTS

MINISTRY OF ENERGY & MINES
ATTN: AL HOFFMAN
PO BOX 9320
VICTORIA BC V8W 9N3

Report On: 22-MAY-06 01:19 PM

Lab Work Order #: L390464 **Date Received:** 19-MAY-06

Project P.O. #:
Job Reference:
Legal Site Desc: PIPE AIR
CofC Numbers: 222509

Comments: Water Samples not preserved or filtered.

APPROVED BY: _____

ALS Canada Limited
Environmental Division
Part of the ALS Laboratory Group
9936-67 Avenue, Edmonton, AB T6E 0P5
Phone: +1 780 413 5227 Fax: +1 780 437 2311 www.alsglobal.com
A Campbell Brothers Limited Company

ALS LABORATORY GROUP ANALYTICAL REPORT

Sample Details/Parameters		Result	Qualifier*	D.L.	Units	Extracted	Analyzed	By	Batch
L390464-2	1B ~ PIPE AIR								
Sample By:	on 19-MAY-06 @ 01:07								
Matrix:	AIR								
	Carbon Monoxide	<1		1	ppm		20-MAY-06		R400919
	Carbon Dioxide	59000		10	ppm		20-MAY-06		R400919
	Nitrogen	92		1	%		20-MAY-06		R400919
	Oxygen	2		1	%		20-MAY-06		R400919
L390464-4	2B ~ 1' < GRADE (PIT)								
Sample By:	on 19-MAY-06 @ 01:07								
Matrix:	AIR								
	Carbon Monoxide	<1		1	ppm		20-MAY-06		R400919
	Carbon Dioxide	57000		10	ppm		20-MAY-06		R400919
	Nitrogen	91		1	%		20-MAY-06		R400919
	Oxygen	2		1	%		20-MAY-06		R400919
L390464-6	3B ~ 5' > GRADE								
Sample By:	on 19-MAY-06 @ 01:07								
Matrix:	AIR								
	Carbon Monoxide	<1		1	ppm		20-MAY-06		R400919
	Carbon Dioxide	10000		10	ppm		20-MAY-06		R400919
	Nitrogen	80		1	%		20-MAY-06		R400919
	Oxygen	18		1	%		20-MAY-06		R400919
L390464-8	CLEAN AIR 2 ~FRESH AIR								
Sample By:	on 19-MAY-06 @ 01:07								
Matrix:	AIR								
	Carbon Monoxide	<1		1	ppm		20-MAY-06		R400919
	Carbon Dioxide	490		10	ppm		20-MAY-06		R400919
	Nitrogen	78		1	%		20-MAY-06		R400919
	Oxygen	21		1	%		20-MAY-06		R400919
L390464-9	SULIVAN MINE WATER SAMPLE								
Sample By:	on 19-MAY-06 @ 01:07								
Matrix:	WATER								
Dissolved Metals									
	GC/MS Characterization of Extractables	See Appendix A				20-MAY-06	20-MAY-06		R400964
	GC/MS Characterization of Volatiles	See Appendix B				20-MAY-06	20-MAY-06		R400987
Routine Water Analysis									

* Refer to Referenced Information for Qualifiers (if any) and Methodology

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client ID	Qualifier	Description
L390464-9	SULIVAN MINE WATER SAM	SFU	Sample filtered to remove particulate - Dissolved metals filtered before analysis
		SRU	Sample Received Unpreserved - Dissolved metals

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Preparation Method Reference(Based On)	Analytical Method Reference(Based On)
C-DIOXIDE-ED	Air	Compressed Breathing Air		GC-TCD/FID
AIHA Accredited analysis in Gas Chromatography Field of Testing				
C-MONOXIDE-ED	Air	Carbon Monoxide		OSHA ID 210-GC-FID
AIHA Accredited analysis in Gas Chromatography Field of Testing				
CL-IND-ED	Water	Chloride (Cl)		APHA 4110 B-Ion Chromatography
ETL-ROUTINE-ICP-ED	Water	ICP metals and SO4 for routine water		APHA 3120 B-ICP-OES
IONBALANCE-ED	Water	Ion Balance Calculation		APHA 1030E
MET1-DIS-LOW-ED	Water	Dissolved Trace Metals (Low Level)		EPA 6020
MET2-DIS-ED	Water	Dissolved Major Metals		EPA 200.7
N2-GC-ED	Air	Compressed Breathing Air		GC-TCD/FID
AIHA Accredited analysis in Gas Chromatography Field of Testing				
NH4-ED	Water	Ammonia-N		APHA4500NH3F Colorimetry
NO2-IND-ED	Water	Nitrite-N		APHA 4110 B Ion Chromatography
NO3-IND-ED	Water	Nitrate-N		APHA 4110 B Ion Chromatography
O2-ED	Air	Percent Oxygen in Air		OSHA 6601-O2 METER
Not an AIHA or CAEAL accredited test service.				
OPENSCAN-EXT-ED	Water	GC/MS Characterization of Extractables		SW846 8270
OPENSCAN-VOC-ED	Water	GC/MS Characterization of Volatiles	EPA 5021	EPA5021/8260
PH/EC/ALK-ED	Water	pH, Conductivity and Total Alkalinity		APHA 4500-H, 2510, 2320
SULPHIDE-ED	Water	Sulphide		APHA 4500 -S E-Auto-Colorimetry

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.

Chain of Custody numbers:

222509

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
ED	ALS LABORATORY GROUP - EDMONTON, ALBERTA, CANADA		

Reference Information

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in environmental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds. The reported surrogate recovery value provides a measure of method efficiency. The Laboratory control limits are determined under column heading D.L.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
< - Less than
D.L. - Detection Limit
N/A - Result not available. Refer to qualifier code and definition for explanation

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION
UNLESS OTHERWISE STATED, SAMPLES ARE NOT CORRECTED FOR CLIENT FIELD BLANKS.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed. ALS Laboratory Group assumes no liability for the use or interpretation of the results.

ALS LABORATORY GROUP ANALYSIS REPORT

SAMPLE DESCRIPTION: Analyze four gasbag samples by Entech canister system - gas chromatography/mass spectrometry to characterize all VOCs.

LAB SAMPLE #	CLIENT I.D.	RESULTS
L390464-1	1A ~ PIPE AIR	Please see below.
L390464-3	2A ~ 1' < GRADE (PIT)	Please see below.
L390464-5	3A ~ 5' > GRADE	Please see below.
L390464-7	CLEAN AIR 1 ~ FRESH AIR	Please see below.

METHODOLOGY:

A portion of the sample from the gasbag was withdrawn through the Entech Model 7032A Autosampler and cryofocused with the Entech 7100A Preconcentrator. The effluent was directed to the gas chromatograph/mass spectrometer (GC/MS) for separation, detection and identification of eluting compounds. The initial temperature was 35°C and programmed ramp to 220°C. Chromatograms are attached.

A pre-cleaned 6L Canister was spiked with 51 ppb (164 ug/m^3) hexane. Quantitation of each compound detected in the sample was performed by comparison to the hexane response to provide a semi-quantitative estimate of amount of each compound. Ethylbenzene_d10 was spiked on-line to serve as an internal standard.

Each compound detected was identified from the mass spectra and a degree of confidence value assigned based on the analyst's confidence in the identification. A legend of these values follows.

ALS LABORATORY GROUP ANALYSIS REPORT

TABLE OF CONFIDENCE OF IDENTIFICATION

NUMBER 1: Very confident, clean spectra, excellent match with library spectrum.

NUMBER 2: Some small spectra differences with library match. A good comparison. Reference standard needed for positive identification.

NUMBER 3: Possible compound or very similar to. Spectrum is definitely contaminated. Reference standard needed for positive identification.

NUMBER 4: Evidence of possible structure and molecular weight. Compound not identified.

NUMBER 5: Unable to identify.

ALS LABORATORY GROUP ANALYSIS REPORT

LAB SAMPLE # L390464-1 **CLIENT I.D.** 1A ~ PIPE AIR

RETENTION TIME (min.)	COMPOUND IDENTIFICATION	CONFIDENCE OF IDENTIFICATION	Air Conc. (ug/m^3)
1.9-2.2	Air	-	-
5.0	Carbon dioxide*	1	-
5.2	Carbonyl sulfide	3	3
5.6	Isobutane	2	3
6.8	Acetonitrile*	2	1
8.4	Carbon disulfide*	1-2	2
9.4	C5 cycloalkane or C5 alkene	3	1
10.5	Hexene	2	1
18.8	C8 alkene or C9 alkane	3	1
19.7	Internal standard	-	-
20.2	C9 alkane or C6 alkanol / Ethylbenzene	2-3	2
26.1	Unknown ether or alkane	3	1
27.1	C10 or C11 alkane	2	1
		Detection Limit:	1
		Total VOC's:	21

*Possible laboratory or instrument contaminant.

LAB SAMPLE # L390464-3 **CLIENT I.D.** 2A ~ 1' < GRADE (PIT)

RETENTION TIME (min.)	COMPOUND IDENTIFICATION	CONFIDENCE OF IDENTIFICATION	Air Conc. (ug/m^3)
1.9-2.2	Air	-	-
4.9-5.0	Carbon dioxide*	1	-
5.3	Carbonyl sulfide / Propane	3	33
5.6	Isobutane / Methanol	2-3	15
5.9	C4 alkene	1-2	8
6.0	Butane	1	16
6.7	Acetonitrile*	1-2	73
7.1	Acetone / C5 cycloalkane or C5 alkene	2-3	18
7.2	Trichloromonofluoromethane	1-2	1
7.3	Isopropyl alcohol	1-2	19
7.6	Pentane	1	28
7.7	C5 alkadiene or Ethylidene cyclopropane	2-3	1
8.0	Methylene chloride* / Dimethyl cyclopropane or C5 alkene	2	9
8.4	Carbon disulfide*	1	14

ALS LABORATORY GROUP ANALYSIS REPORT

LAB SAMPLE # L390464-3 **CLIENT I.D.** 2A ~ 1' < GRADE (PIT)

RETENTION TIME (min.)	COMPOUND IDENTIFICATION	CONFIDENCE OF IDENTIFICATION	Air Conc. (ug/m^3)
8.6	Unknown cycloalkene	3-4	1
9.4	C5 alkene or C5 cycloalkane	3	4
9.5	C6 alkane	1-2	19
9.7	Butanal	2	2
10.0	C6 alkane	2	1
10.5	Hexane	1	14
10.7	Chloroform	1-2	2
11.9	1,1,1-Trichloroethane	1-2	1
12.8	Cyclohexane	2	3
13.0	C7 alkane	2	1
13.1	C6 alkene	2	2
13.4	C5 alkanal / C7 alkene	2-3	5
14.2	Hexene	2	3
15.2	Methyl Isobutyl Ketone / Methyl cyclohexane	2-3	4
15.6	C7 alkane	2	1
16.5	Toluene	1	4
16.7	3,4-Dihydro-2H-pyran	2-3	2
17.9	C8 alkane	2-3	1
18.2	Tetrachloroethylene	1	1
18.6	Hexamethyl cyclotrisiloxane	2	3
18.8	C9 alkane	1-2	20
19.7	Internal standard	-	-
20.0	C9 alkane	1-2	3
20.2	C9 alkane	1-2	34
20.5	Cyclohexanone	2-3	1
23.2	Phenol	1	2
24.2	Unidentified compounds	5	8
24.5	C9 or C10 alkane	2-3	1
24.9	C7 alkanol	2	3
25.1	C4 alkyl benzene	2	1
25.4	Limonene or similar terpene	1-2	8
25.7	Unknown alkene / alkane	3	1
26.0	C10 alkane	2-3	1
26.1	C11 alkane	2	21
26.2	C11 alkane	3	2
26.3	C11 alkane	2	11
26.6	Unknown cycloalkane	2-3	2
27.0	C11 alkane	2	5
27.1	C12 alkane	2	37

ALS LABORATORY GROUP ANALYSIS REPORT

LAB SAMPLE # L390464-3 **CLIENT I.D.** 2A ~ 1' < GRADE (PIT)

RETENTION TIME (min.)	COMPOUND IDENTIFICATION	CONFIDENCE OF IDENTIFICATION	Air Conc. (ug/m^3)
27.2	C12 alkane	2	16
27.3	C12 alkane	2	9
27.7	C12 alkane	2-3	2
28.0	Unknown silyl compound	3	5
28.7	Naphthalene	1-2	1
28.8	Dodecane	2	1
30.3	C13 alkane	2	2
31.0	Unknown silyl compound / C13 alkane	3	2
		Detection Limit:	1
		Total VOC's:	550

*Possible laboratory or instrument contaminant.

LAB SAMPLE # L390464-5 **CLIENT I.D.** 3A ~ 5' > GRADE

RETENTION TIME (min.)	COMPOUND IDENTIFICATION	CONFIDENCE OF IDENTIFICATION	Air Conc. (ug/m^3)
1.9-2.2	Air	-	-
5.0	Carbon dioxide*	1	-
5.3	Carbonyl sulfide	3	4
5.7	Methanol	1-2	11
6.0	Butane	3	2
6.8	Acetonitrile*	1-2	8
7.0	Acetone	1-2	9
7.2	Trichloromonofluoromethane	1-2	1
7.3	1-Methoxy-2-propanone	2	4
7.6	Pentane	2	8
8.0	Methylene chloride*	1	10
8.4-8.6	Carbon disulfide*	1	210
9.5	C6 alkane	1-2	3
10.5	Hexane	2	5
16.4	Toluene	1	3
18.8	C9 alkane	1-2	3
19.7	Internal standard	-	-
20.2	C9 alkane / Ethylbenzene	2	9
24.2	Unknown alkyl benzene	3	2
25.4	Limonene or similar terpene	2	3
26.1	C11 alkane	2	5

ALS LABORATORY GROUP ANALYSIS REPORT

LAB SAMPLE # L390464-5 **CLIENT I.D.** 3A ~ 5' > GRADE

RETENTION TIME (min.)	COMPOUND IDENTIFICATION	CONFIDENCE OF IDENTIFICATION	Air Conc. (ug/m^3)
26.3	C11 alkane	2-3	2
27.0	C11 alkane	2-3	2
27.1	C12 alkane	2	10
27.2	C12 alkane	2	7
27.3	C12 alkane	2	4
28.8	Dodecane	2	4
		Detection Limit:	1
		Total VOC's:	400

*Possible laboratory or instrument contaminant.

LAB SAMPLE # L390464-7 **CLIENT I.D.** CLEAN AIR 1 ~ FRESH AIR

RETENTION TIME (min.)	COMPOUND IDENTIFICATION	CONFIDENCE OF IDENTIFICATION	Air Conc. (ug/m^3)
1.9-2.2	Air	-	-
5.0	Carbon dioxide*	1	-
5.3	Carbonyl sulfide	2	16
5.7	Isobutane / Methanol	2-3	9
5.9	C4 alkene	2-3	2
6.5	Ethanol	2-3	1
6.8	Acetonitrile*	1-2	10
7.0	Acetone	1-2	9
7.2	Trichloromonofluoromethane	1-2	1
7.3	Isopropyl alcohol	1-2	12
7.6	Pentane	1	3
8.0	Methylene chloride*	1	7
8.4	Carbon disulfide*	1	67
9.4	C5 alkene or C5 cycloalkane	3	2
9.5	C6 alkane	1-2	11
10.5	Hexane	1	8
11.6	C6 alkene or C6 cycloalkane	2-3	1
12.8	Cyclohexane	2	2
16.5	Toluene	1	2
18.6	C8 alkane / Unknown siloxane	2-3	1
18.8	C9 alkane	1-2	15
19.7	Internal standard	-	-
20.0	C9 alkane	2	2

ALS LABORATORY GROUP ANALYSIS REPORT

LAB SAMPLE # L390464-7 **CLIENT I.D.** CLEAN AIR 1 ~ FRESH AIR

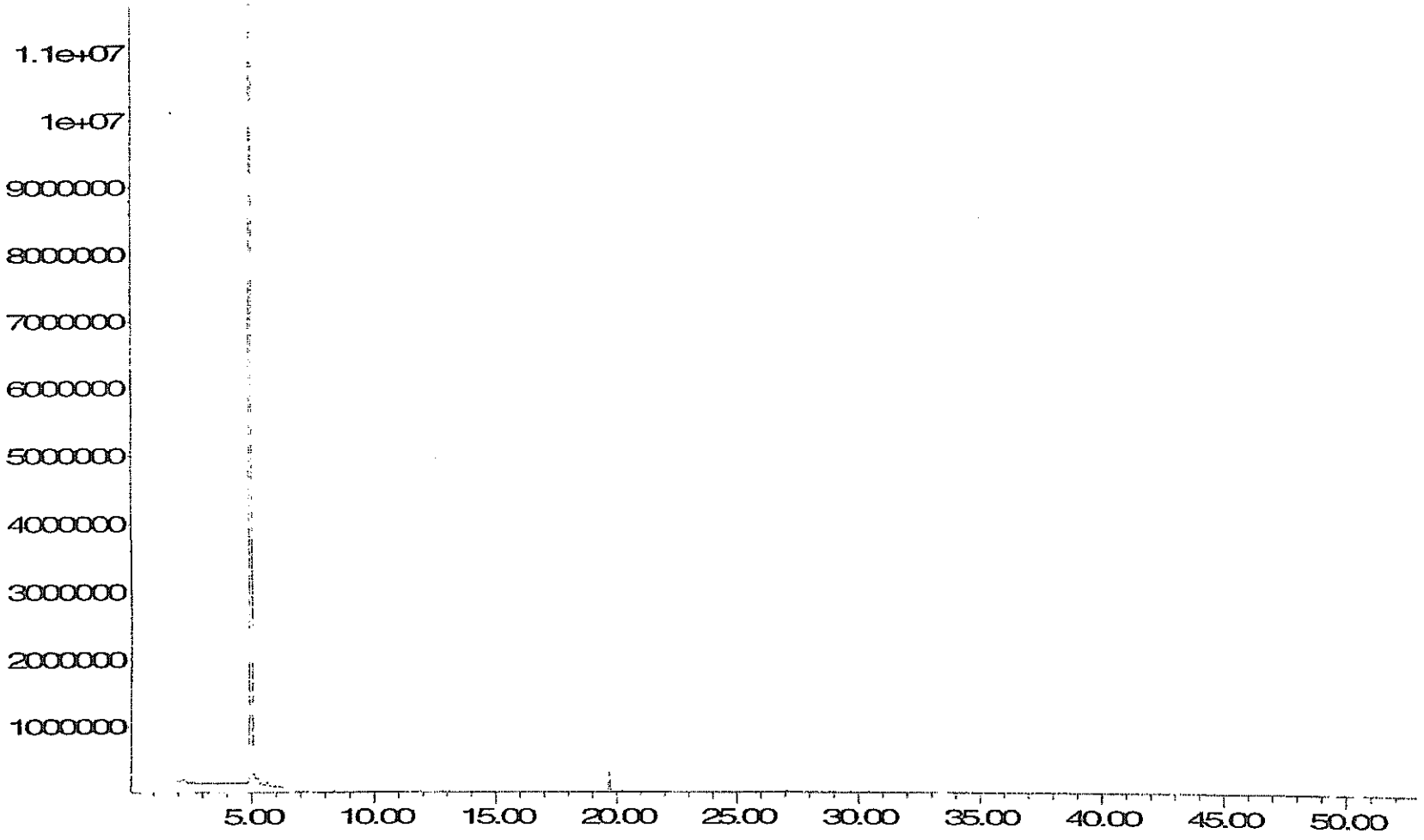
RETENTION TIME (min.)	COMPOUND IDENTIFICATION	CONFIDENCE OF IDENTIFICATION	Air Conc. (ug/m^3)
20.2	C9 alkane	1-2	24
24.2	Unknown alkyl benzene	3	2
24.5	C9 or C10 alkane	2-3	2
24.9	Unknown alkene	3	2
25.4	Limonene or similar terpene	1-2	17
26.0	C10 alkane	2-3	1
26.1	C11 alkane	2	10
26.2	C11 alkane	3	1
26.3	C11 alkane	2-3	4
26.6	Unknown cycloalkane	3-4	1
27.0	C11 alkane	2	3
27.1	C12 alkane	2	17
27.2	C12 alkane	2	8
27.3	C12 alkane	2	4
28.0	Unknown silyl compound	3	1
28.7	Naphthalene / C12 alkane	3	1
28.8	C12 alkane	2-3	2
		Detection Limit:	1
		Total VOC's:	330

*Possible laboratory or instrument contaminant.

ALS LABORATORY GROUP ANALYSIS REPORT

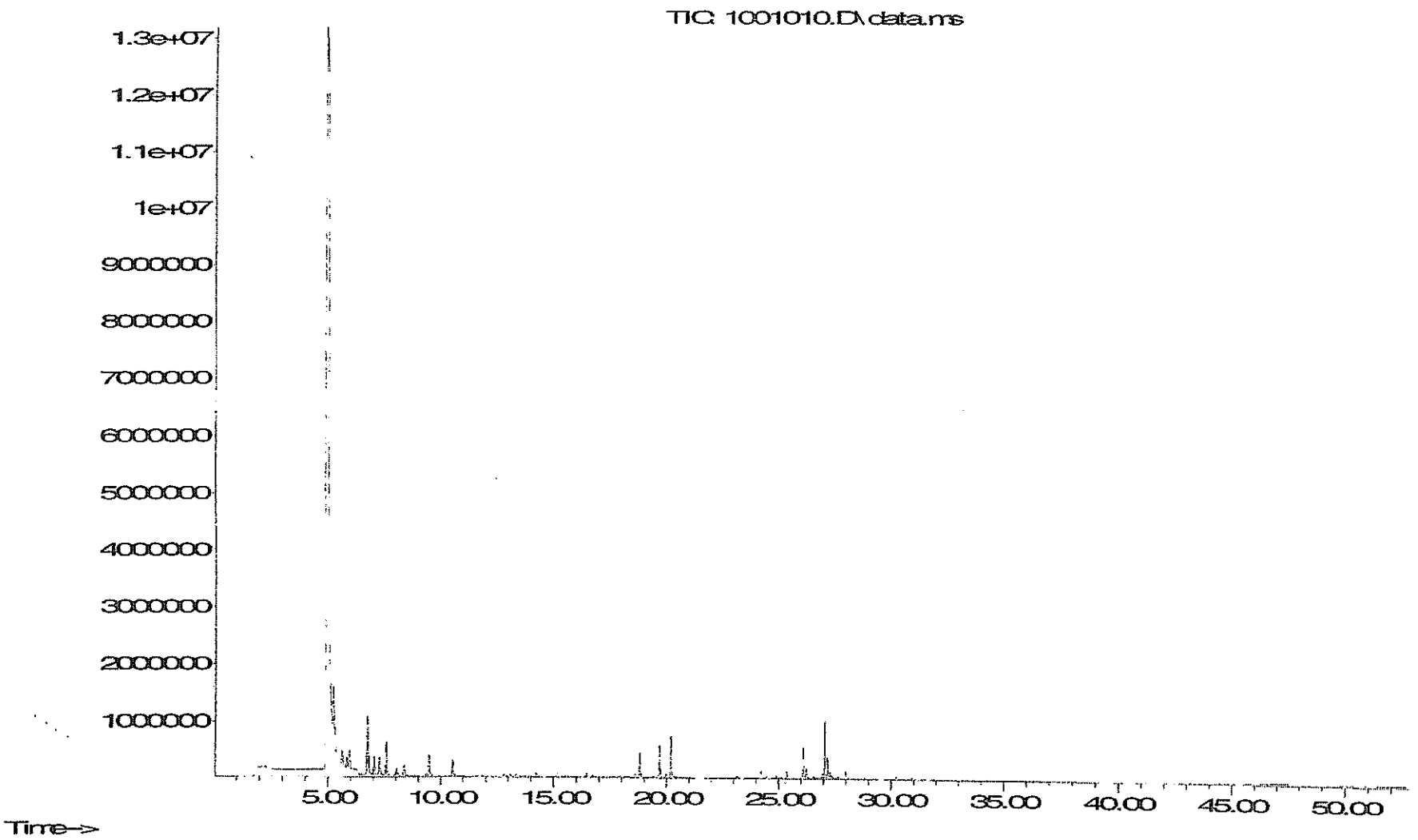
L390464-1
Abundance

TIC: 0901009.D\data.ms



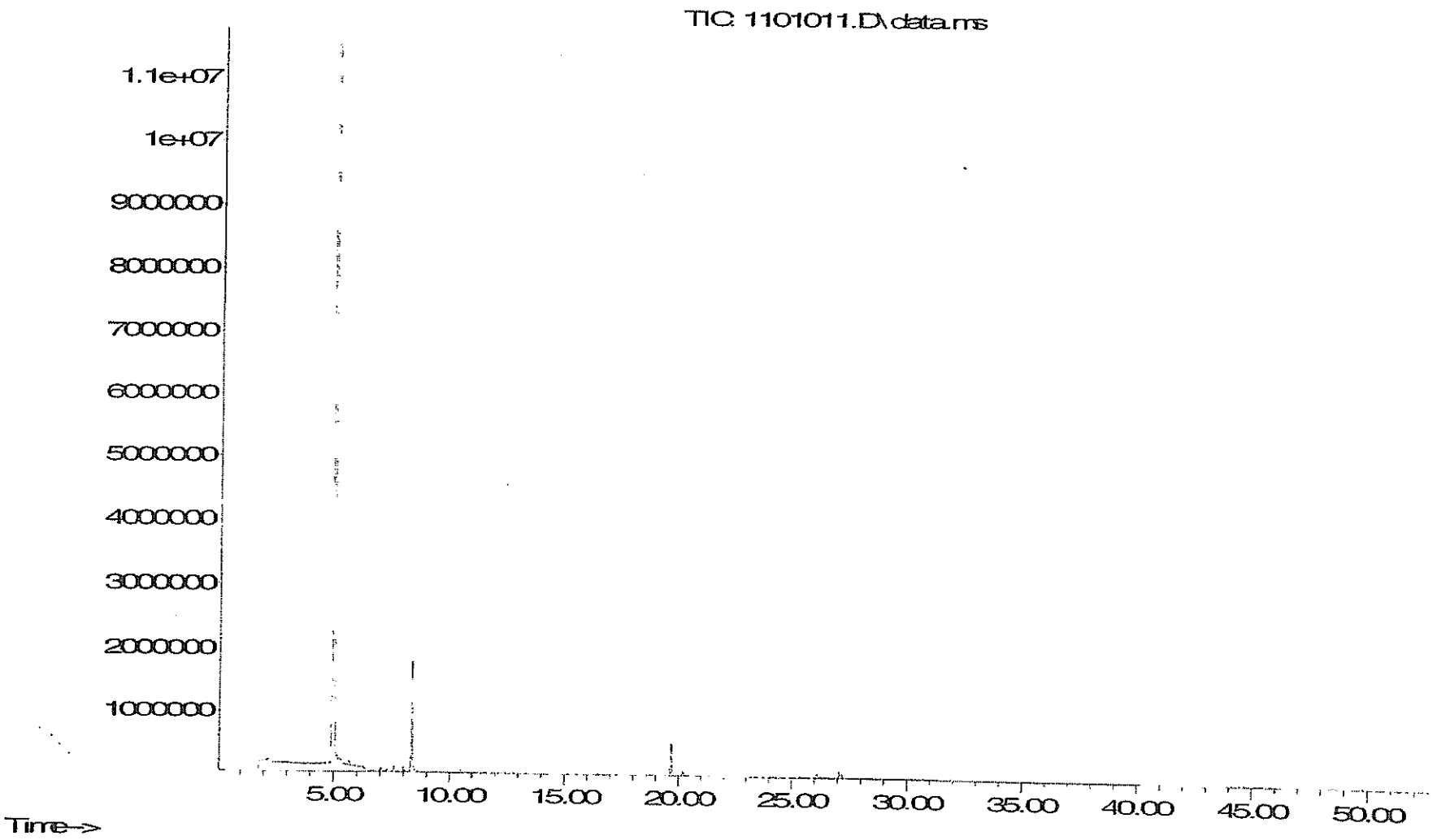
ALS LABORATORY GROUP ANALYSIS REPORT

L390464-3
Abundance



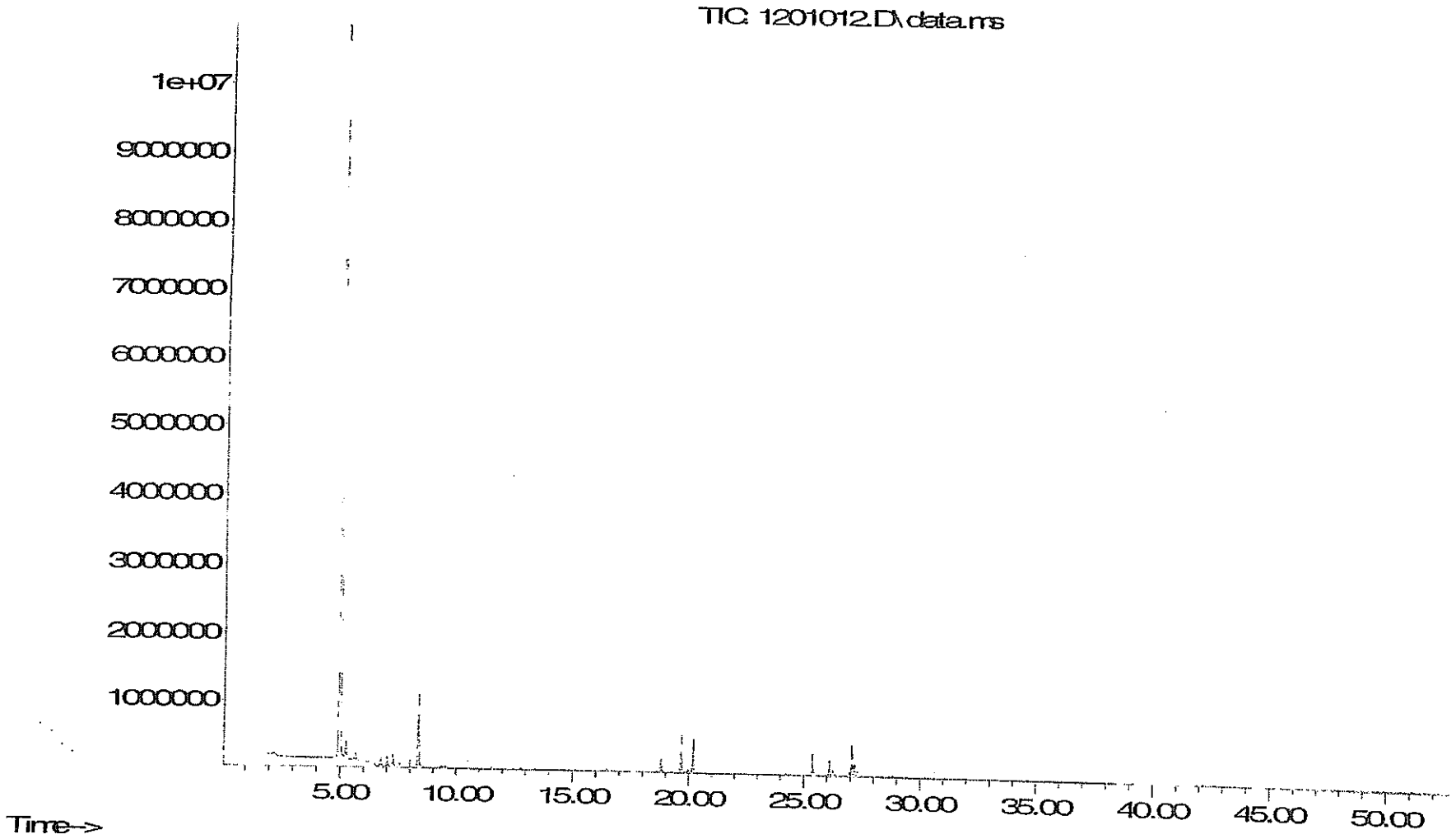
ALS LABORATORY GROUP ANALYSIS REPORT

L390464-5
Abundance



ALS LABORATORY GROUP ANALYSIS REPORT

L390464-7
Abundance



ALS LABORATORY GROUP CHEMICAL ANALYSIS REPORT

ALS LAB SAMPLE ID: L390464-1
CLIENT SAMPLE ID: 1A ~ PIPE AIR

COMPOUND:	DETECTION LIMIT	UNITS	AIR CONCENTRATION (ppb)	AIR CONCENTRATION (ug/m^3)
Hydrogen Sulfide	10	ppb	<10	<20

ALS LAB SAMPLE ID: L390464-3
CLIENT SAMPLE ID: 2A ~ 1' < GRADE (PIT)

COMPOUND:	DETECTION LIMIT	UNITS	AIR CONCENTRATION (ppb)	AIR CONCENTRATION (ug/m^3)
Hydrogen Sulfide	10	ppb	<10	<20

ALS LAB SAMPLE ID: L390464-5
CLIENT SAMPLE ID: 3A ~ 5' > GRADE

COMPOUND:	DETECTION LIMIT	UNITS	AIR CONCENTRATION (ppb)	AIR CONCENTRATION (ug/m^3)
Hydrogen Sulfide	10	ppb	<10	<20

ALS LAB SAMPLE ID: L390464-7
CLIENT SAMPLE ID: CLEAN AIR 1 ~ FRESH AIR

COMPOUND:	DETECTION LIMIT	UNITS	AIR CONCENTRATION (ppb)	AIR CONCENTRATION (ug/m^3)
Hydrogen Sulfide	10	ppb	<10	<20

METHODOLOGY: EPA TO15 - GC/MASS SPEC. (modified for gasbags)

APPENDIX D
ALS WATER QUALITY ANALYSIS REPORT
(RESCAN, MAY 20, 2006)

ALS Environmental

CERTIFICATE OF ANALYSIS

Date:	May 25, 2006
ALS File No.	X6065
	795-1
Report On:	MEM 246-0 Water Analysis
Report To:	**Rescan Environmental Services** Sixth Floor 1111 West Hastings Street Vancouver, BC V6E 2J3
Attention:	
Received:	May 23, 2006

ALS ENVIRONMENTAL
per:

ALS CANADA LTD.
1988 Triumph Street, Vancouver BC Canada V5L 1K5
Phone: 604-253-4188 Fax: 604-253-6700 Website: www.alsenviro.com

File No. X6065

REMARKS

These samples were handled following protocols dictated by ALS' Level 1 Legal Handling procedures. Samples arrived in a sealed cooler, and were tracked after arrival on the ALS Legal Chain of Custody. All samples were kept in locked storage when not in use. Copies of the ALS Legal COC are attached.

The detection limits for some total and dissolved metals were increased for the samples reported due to interferences encountered during analysis.

For some of the submitted water samples, the measured concentration of specific dissolved parameters is greater than the corresponding total parameters concentration. The explanation for these findings is one or a combination of the following:

- laboratory method variability;
- field sampling method variability;
- bias introduced during general handling, storage, transportation and/or analysis of the sample;
- field sample grab bias - where separate grab samples are processed to produce total and dissolved samples;
- field sample split bias - where total and dissolved parameters samples are produced from the same grab sample.

For further clarification on any of the above information, please contact your ALS representative.

File No. X6065

RESULTS OF ANALYSIS - Water

Sample ID			1A	1B	Travel Blank
Sample Date			06-05-20	06-05-20	
Sample Time			08:20	08:25	
ALS ID			*1*	*2*	*3*
Physical Tests					
Colour	(CU)		75.7	73.7	<5.0
Conductivity	(uS/cm)		16000	15900	<2.0
Total Dissolved Solids			30800	34300	<10
Hardness	CaCO3		8070	8030	<0.54
pH			3.27	3.27	5.89
Total Suspended Solids			21.1	44.4	<3.0
Turbidity	(NTU)		7.82	6.75	<0.10
Dissolved Anions					
Acidity (to pH 8.3)		CaCO3	11300	11600	1.8
Alkalinity-Total		CaCO3	<2.0	<2.0	<2.0
Bromide	Br		<0.50	<0.50	<0.050
Chloride	Cl		40.5	40.5	<0.50
Fluoride	F		18.5	20.8	<0.020
Sulphate	SO4		19500	18900	<0.50
Nutrients					
Ammonia Nitrogen		N	6.26	5.05	<0.0050
Total Kjeldahl Nitrogen		N	6.05	6.24	<0.050
Nitrate Nitrogen		N	31.4	31.2	<0.0050
Nitrite Nitrogen		N	0.046	0.030	<0.0010
Total Nitrogen		N	43.2	44.6	<0.050
Total Phosphate		P	0.0633	0.0673	<0.0020
Cyanides					
Total Cyanide	CN		0.0013	<0.0010	-

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

File No. X6065

RESULTS OF ANALYSIS - Water

Sample ID		1A	1B	Travel Blank
Sample Date		06-05-20	06-05-20	
Sample Time		08:20	08:25	
ALS ID		*1*	*2*	*3*
Total Metals				
Aluminum	T-Al	843	875	<0.0010
Antimony	T-Sb	<0.10	<0.10	<0.00010
Arsenic	T-As	<0.10	<0.10	<0.00010
Barium	T-Ba	<0.050	<0.050	<0.000050
Beryllium	T-Be	<0.50	<0.50	<0.00050
Bismuth	T-Bi	<0.50	<0.50	<0.00050
Boron	T-B	<10	<10	<0.010
Cadmium	T-Cd	2.98	3.09	<0.000050
Calcium	T-Ca	442	442	<0.050
Chromium	T-Cr	<0.50	<0.50	<0.00050
Cobalt	T-Co	2.22	2.30	<0.00010
Copper	T-Cu	1.83	1.87	<0.00010
Iron	T-Fe	122	121	<0.030
Lead	T-Pb	0.292	0.286	<0.000050
Lithium	T-Li	<5.0	<5.0	<0.0050
Magnesium	T-Mg	1670	1670	<0.10
Manganese	T-Mn	673	712	<0.000050
Mercury	T-Hg	0.000268	0.000167	<0.000050
Molybdenum	T-Mo	<0.050	<0.050	<0.000050
Nickel	T-Ni	4.25	4.44	<0.00050
Phosphorus	T-P	<3.0	<3.0	<0.30
Potassium	T-K	30	30	<2.0
Selenium	T-Se	<1.0	<1.0	<0.0010
Silicon	T-Si	33.6	33.5	<0.050
Silver	T-Ag	<0.010	<0.010	<0.000010
Sodium	T-Na	35	35	<2.0
Strontium	T-Sr	1.39	1.44	<0.00010
Thallium	T-Tl	<0.10	<0.10	<0.00010
Tin	T-Sn	<0.10	<0.10	<0.00010
Titanium	T-Ti	<0.10	<0.10	<0.010
Uranium	T-U	0.171	0.177	<0.000010
Vanadium	T-V	<1.0	<1.0	<0.0010
Zinc	T-Zn	4140	4320	<0.0010

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

File No. X6065

RESULTS OF ANALYSIS - Water

Sample ID			1A	1B
Sample Date			06-05-20	06-05-20
Sample Time			08:20	08:25
ALS ID			*1*	*2*
Dissolved Metals				
Aluminum	D-Al		838	848
Antimony	D-Sb		<0.10	<0.10
Arsenic	D-As		<0.10	<0.10
Barium	D-Ba		<0.050	<0.050
Beryllium	D-Be		<0.50	<0.50
Bismuth	D-Bi		<0.50	<0.50
Boron	D-B		<10	<10
Cadmium	D-Cd		3.05	2.88
Calcium	D-Ca		440	441
Chromium	D-Cr		<0.50	<0.50
Cobalt	D-Co		2.23	2.27
Copper	D-Cu		1.94	1.86
Iron	D-Fe		120	121
Lead	D-Pb		0.292	0.273
Lithium	D-Li		<5.0	<5.0
Magnesium	D-Mg		1690	1680
Manganese	D-Mn		676	688
Mercury	D-Hg		0.000235	0.000205
Molybdenum	D-Mo		<0.050	<0.050
Nickel	D-Ni		4.48	4.27
Phosphorus	D-P		<3.0	<3.0
Potassium	D-K		30	30
Selenium	D-Se		<1.0	<1.0
Silicon	D-Si		33.4	33.5
Silver	D-Ag		<0.010	<0.010
Sodium	D-Na		35	35
Strontium	D-Sr		1.41	1.39
Thallium	D-Tl		<0.10	<0.10
Tin	D-Sn		<0.10	<0.10
Titanium	D-Ti		<0.10	<0.10
Uranium	D-U		0.176	0.173
Vanadium	D-V		<1.0	<1.0
Zinc	D-Zn		4190	4200
Organic Parameters				
Total Organic Carbon		C	19.2	18.7

Remarks regarding the analyses appear at the beginning of this report.
Results are expressed as milligrams per litre except where noted.
< = Less than the detection limit indicated.

File No. X6065

Appendix 1 - METHODOLOGY

Outlines of the methodologies utilized for the analysis of the samples submitted are as follows

Colour in Water

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (true colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. The analysis is carried out without pH adjustment.

Recommended Holding Time:
Sample: 2 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Conductivity in Water

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

Recommended Holding Time:
Sample: 28 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Solids in Water

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total dissolved solids (TDS) and total suspended solids (TSS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius, TSS is determined by drying the filter at 104 degrees celsius. Total solids are determined by evaporating a sample to dryness at 104 degrees celsius. Fixed and volatile solids are determined by igniting a dried sample residue at 550 degrees celsius.

Recommended Holding Time:
Sample: 7 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

pH in Water

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

Recommended Holding Time:
Sample: 2 hours
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Turbidity of Water

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

Recommended Holding Time:
Sample: 2 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Acidity in Water

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

Recommended Holding Time:
Sample: 14 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Alkalinity in Water by Colourimetry

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

Recommended Holding Time:
Sample: 14 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Dissolved Anions in Water by Ion Chromatography

This analysis is carried out using procedures adapted from APHA Method 4110 "Determination of Anions by Ion Chromatography" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Anions are determined by filtering the sample through a 0.45 micron membrane filter and injecting the filtrate onto a Dionex IonPac AG17 anion exchange column with a hydroxide eluent stream. Anions routinely determined by this method include: bromide, chloride, fluoride, nitrate, nitrite and sulphate.

Recommended Holding Time:
Sample: 28 days (bromide, chloride, fluoride, sulphate)
Sample: 2 days (nitrate, nitrite)
Reference: APHA and EPA

Laboratory Location: ALS Environmental, Vancouver

Ammonia in Water by Selective Ion Electrode

This analysis is carried out, on sulphuric acid preserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using an ammonia selective electrode.

Recommended Holding Time:
Sample: 28 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Total Kjeldahl Nitrogen in Water

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total kjeldahl nitrogen is determined by sample digestion at 367 celcius with analysis using an ammonia selective electrode.

Recommended Holding Time:
Sample: 28 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Total Kjeldahl Nitrogen and Total Nitrogen in Water

This analysis is carried out using procedures adapted from ASTM Method D 5176-91 "Standard Test Method for Total Chemically Bound Nitrogen in Water by Pyrolysis and Chemiluminescence detection." Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation. Total Kjedahl Nitrogen is determined by calculation.

Recommended Holding Time:
Sample: 28 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Phosphate in Water

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". All forms of phosphate are determined by the ascorbic acid colourimetric method. Dissolved ortho-phosphate (dissolved reactive phosphorous) is determined by direct measurement. Total phosphate (total phosphorous) is determined after persulphate digestion of a sample. Total dissolved phosphate (total dissolved phosphorous) is determined by filtering a sample through a 0.45 micron membrane filter followed by persulfate digestion of the filtrate.

Recommended Holding Time:
Sample: 2 days
Reference: EPA

Laboratory Location: ALS Environmental, Vancouver

Cyanide Species in Water

This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide and weak acid dissociable (WAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method. Cyanate is determined by the cyanate hydrolysis method using an ammonia selective electrode. Thiocyanate is determined by the ferric nitrate colourimetric method.

Recommended Holding Time:
Sample: 14 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Metals in Water

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" 20th Edition 1998 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotplate or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by atomic absorption/emission spectrophotometry (EPA Method 7000 series), inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B), and/or inductively coupled plasma - mass spectrometry (EPA Method 6020).

Recommended Holding Time:
Sample: 6 months
Reference: EPA

Laboratory Location: ALS Environmental, Vancouver

Mercury in Water

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" 20th Edition 1998 published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

Recommended Holding Time:
Sample: 28 days
Reference: EPA

Laboratory Location: ALS Environmental, Vancouver

Carbon in Water

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". All fractions of carbon are determined by the combustion-infrared method. Total carbon includes organic carbon (covalently bonded in organic molecules) and inorganic carbon (carbonate, bicarbonate and dissolved carbon dioxide). Total organic carbon is the calculated difference between the total carbon and the inorganic carbon determination. Dissolved carbon fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.

Recommended Holding Time:
Sample: 28 days
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Ammonia in Water by Colourimetry

This analysis is carried out, on unpreserved samples, using procedures adapted from APHA Method 4500-NH3 "Nitrogen (Ammonia)". Ammonia is determined using the phenate colourimetric method.

Recommended Holding Time:
Sample: 1 day
Reference: APHA

Laboratory Location: ALS Environmental, Vancouver

Results contained within this certificate relate only to the samples as submitted.

End of Report

LEGAL SAMPLING CHAIN OF CUSTODY FORM

PAGE 1 OF 3

CLIENT:	Rescan
ADDRESS:	
TEL:	FAX:
CONTACT NAME:	
PROJECT NAME:	
DATE SUBMITTED:	
ALS LEAD ANALYST:	
QUOTE/PO #:	

1988 Triumph Street
Vancouver, BC
Canada V5L 1K5
TEL: 604-253-4188
TOLLFREE: 1-800-665-0243
FAX: 604-253-6700
www.alsenviro.com

NOTES: This document must stay with the legal samples at all times

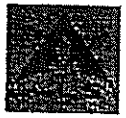
RELINQUISHED BY (name of person/company)	DATE/TIME RELINQUISHED Y	M	D			RECEIVED BY (name of person/company)
	6	5	23	11 : 20	AM PM	
	6	5	23	11 : 33	AM PM	
	6	5	23	1 : 12	AM PM	
	6	5	23	1 : 20	AM PM	
	6	5	23	2 : 03	AM PM	
	6	5	23	2 : 22	AM PM	
	6	5	23	2 : 25	AM PM	
	6	5	23	2 : 26	AM PM	
	6	5	23	2 : 58	AM PM	
	6	5	23	3 : 12	AM PM	
	6	5	23	4 : 02	AM PM	
	6	5	23	4 : 24	AM PM	

6 5 23 4 48 pm

6 5 23 5 15 pm

LEGAL SAMPLING CHAIN OF CUSTODY FORM

CLIENT:	RESCAN
ADDRESS:	
TEL:	FAX:
CONTACT NAME:	
PROJECT NAME:	X6065
DATE SUBMITTED:	
ALS LEAD ANALYST:	
QUOTE/PO#:	



1988 Triumph Street
Vancouver, BC
Canada V5L 1K5
TEL: 604-253-4188
TOLLFREE: 1-800-665-0243
FAX: 604-253-6700
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NOTES : This document must stay with the legal samples at all times

DATE/TIME RELINQUISHED (Y M D)				(person/company)
2006	05	23	06 : 45 AM PM	
2006	05	23	06 : 40 AM PM	
06	05	24	8 : 45 AM PM	
6	5	24	9 : 30 AM PM	
6	5	24	10 : 18 AM PM	
6	5	24	10 : 18 AM PM	
6	5	24	10 : 30 AM PM	
6	5	24	10 : 30 AM PM	
6	5	24	11 : 40 AM PM	
6	5	24	12 : 20 AM PM	
	5	24	1 : 10 AM PM	
2006	5	24	2 : 01 AM PM	

LEGAL SAMPLING CHAIN OF CUSTODY FORM

PAGE 3 OF 5

CLIENT:	KLESCAW
ADDRESS:	
TEL:	FAX:
CONTACT NAME:	
PROJECT NAME:	
DATE SUBMITTED:	
ALS LEAD ANALYST:	
QUOTE/PO#:	

X6065

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RELINQUISHED BY (name of person/company)	DATE/TIME RELINQUISHED Y	M	D			PERFORMED BY (name of person/company)	
	2006	5	24	2 : 40	AM PM		
	2006	5	24	2 : 45	AM PM		
	2006	5	24	2 : 59	AM PM		
	2006	5	24	6 : 04	AM PM		
	2006	5	24	11 : 00	AM PM		
	2006	5	25	10 : 34	AM PM		
	2006	5	25	3 : 57	AM PM		
/				:	AM PM	/	
/				:	AM PM	/	
/				:	AM PM	/	
/				:	AM PM	/	
/				:	AM PM	/	

Form # 0185
Revision 2

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Calgary, AB #2 - 21 Highfield Circle SE T2G 5N6 Tel: 403-214-5431 Toll Free: 1-866-722-6231 Fax: 403-214-5430
Burlington, ON 5420 Mainway Drive, Unit 5 L7L 6A4 Tel: 905-331-3111 Toll Free: 1-888-257-3684 Fax: 905-331-4567

51368

CHAIN OF CUSTODY FORM

PAGE 1 OF 1

SEND REPORT TO:

CLIENT: RESCAN Environmental Services ATTN.:
ADDRESS: 6th Floor, 1111 West Hastings Street.
CITY: Vancouver PROV.: BC POSTAL CODE: V6E 2J3
TELEPHONE: 604 6577260 FAX: 604 687 4277 SAMPLER:
PROJECT NAME & NO.: MOEM 246-0 QUOTE NO.:
PO NO.: ALS CONTACT:
REPORT FORMAT: ☑ HARDCOPY ☑ EMAIL - ADDRESS: @rescan.com
☐ FAX ☑ EXCEL ☑ PDF ☐ OTHER:

ANALYSIS REQUESTED:

X606	SAMPLE IDENTIFICATION	DATE / TIME COLLECTED YYYY-MM-DD	TIME	MATRIX	General Parameters (All)	TOC	Dissolved Metals	Total Metals	Cyanide	NOTES (sample specific comments, due dates, etc.)
	1A	2006-05-20	8:20 AM	H_2O	X	X	X	X	X	
	1B	2006-05-20	9:25AM	H_2O	X	X	X	X	X	

FOR LAB USE ONLY

TURN AROUND REQUIRED: ☐ ROUTINE ☑ RUSH - SPECIFY DATE: (surcharge may apply)

SEND INVOICE TO: ☑ SAME AS REPORT INVOICE FORMAT: ☐ HARDCOPY ☐ PDF ☐ FAX
☐ DIFFERENT FROM REPORT (provide details below)

SPECIAL INSTRUCTIONS:
Use lowest available detection limit. Legal Samples.

RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
	23/5/06	9:58 AM			
RELINQUISHED BY:	DATE	TIME	RECEIVED BY:	DATE	TIME
				6/5/23	10:05.

FOR LAB USE ONLY

COOLER SEAL INTACT? ☐ YES ☐ NO ☐ N/A
SAMPLE TEMPERATURE: 17° °C FROZEN? ☐ YES ☐ NO
COOLING METHOD? ☒ ICEPACKS ☐ ICE ☐ NONE

SEE WHITEPAPER FORM VERSION: R_08

APPENDIX E

MICROMED MICROBIAL ANALYSIS REPORT (RESCAN, MAY 20, 2006)

IG MicroMed Environmental
190 - 12860 Clarke Place, Richmond, B.C. V6V
Tel: (604) 279-0666 Fax: (604) 279-

Environmental Engineer
Rescan Environmental Services Ltd.
Sixth Floor, 111 West Hastings Street
Vancouver, B.C.
V6E 2J3

Ph: (604) 689-9460

12 June, 2006

ence No: 117962.

These are the results of the samples received May 23.

Product Sampled: Two various samples were received in the laboratory for ana

Product:	Heterotrophic Plate Count	Sulphate Reducers	drocarbon ers – Diesel Fuel
Sample #: 1 1A 8:10 a.m.	7	Not seen microscopically.	<50
Sample #: 2 1B 8:10 a.m.	9	Not seen microscopically.	<50

Note: All positive and negative controls, media sterility and media performance c ere found to be satisfactory.

All results are for cfu's per ml or per 100 mls of sample.

FILE: KIMBERLEY INCIDENT

Teck Cominco Limited
Technology Division
#600 - 200 Burrard Street
Vancouver, B.C. V6C 3L9

teckcominco

MEMORANDUM

Memo To: Walter Kuit **Date:** June15th, 2006
From:

Re: Airborne Thermal Infrared Survey, Sullivan Waste Dump No. 1

An airborne survey was arranged to collect thermal infrared data over the No. 1 waste dump at the Sullivan Mine in the days following the incident that led to four fatalities at the mine site between May 15th and May 17th, 2006. The objective was to identify any thermal anomalies that might indicate a heat source beneath the till cover that had been applied to seal and re-slope the underlying waste dump material. The survey was completed on May 30th and May 31st and the data for the flight lines over the accident site and waste dump has been arriving over the past 2 or 3 weeks and compiled. We also were able to locate detailed orthophotos and digital contour maps with 0.5m accuracy from a survey done by McElhaney in 2005. This was used for reference and ground control.

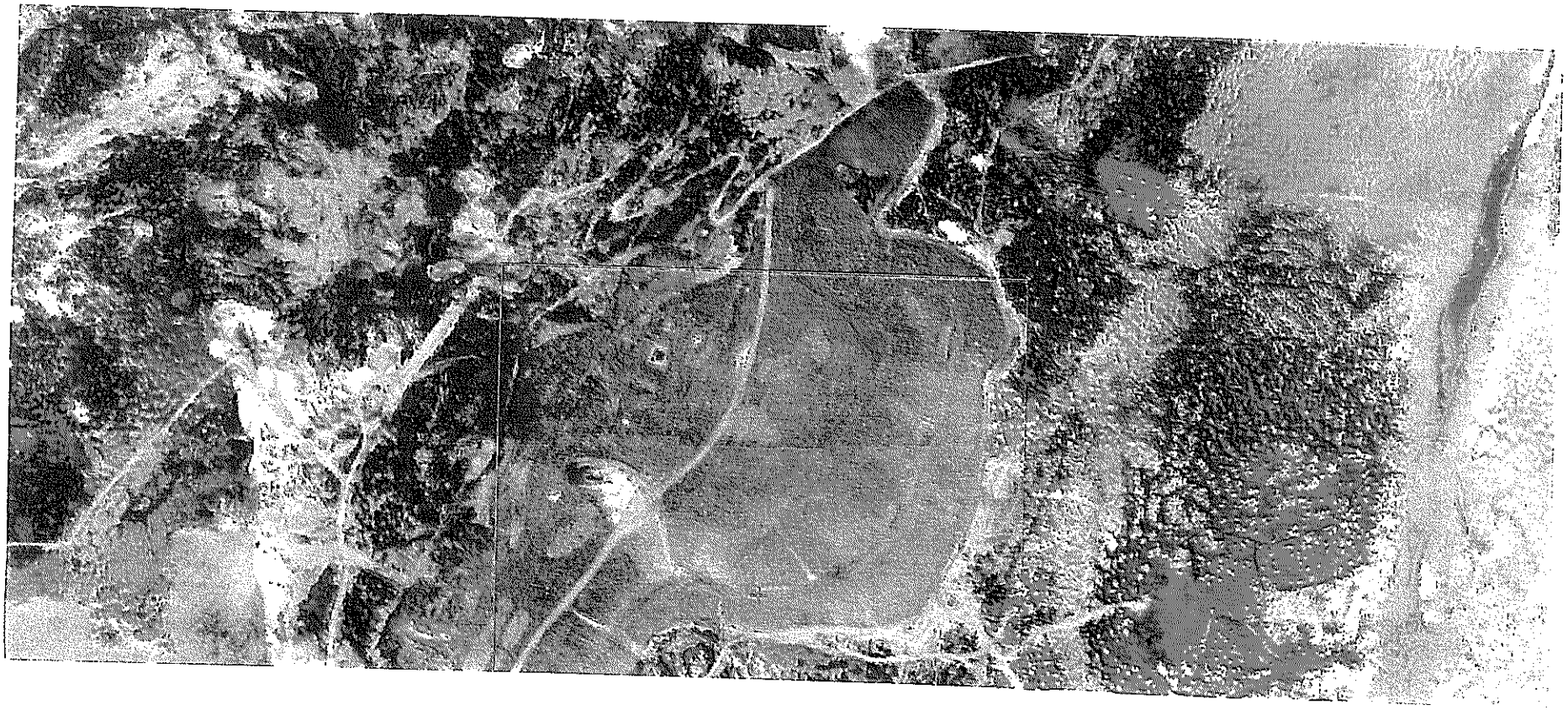
Four areas were covered by the survey but we have only received data for the important No. 1 waste dump to date. The image analysis and statistical work that I have been doing with the raw data provided seems to indicate that there is no obvious "hot spot" that can be identified. There are irregularities and anomalous areas that should be explained for the sake of completeness, but in general the waste dump cover appears to be homogeneous and the temperatures measured over the dump varied by less than 2°C. I believe that most of the variations will be explained by moisture content and variations in the composition and texture of the till cover. However, we can't be certain of this until some of the areas identified have been checked on the ground.

Three sets of thermal IR data were collected: mid-wave thermal and long-wave thermal IR instruments were flown separately on the evening of May 30th, just after sunset; and a further mid-wave thermal survey was flown the following morning. The mid wave camera is far more sensitive, and was used to compare evening and morning readings to get an idea of the characteristic thermal inertia properties of materials on the ground. This is done by subtracting the morning readings from the evening readings to measure the rate of cooling. This information was gathered at a resolution of 0.75m pixels. The long wave instrument is capable of calibration to true ground temperatures but has a much coarser resolution of approximately 2m. All three data sets were corrected for aircraft altitude, pitch, yaw and roll, and then geometrically registered to the McElhaney orthophotos. I spent some time looking at the quality of the data and did various statistical analyses to look for any anomalous patterns over the dump or near the shed where the accident happened.

I've printed out various maps with this memo, and compiled some close up figures (Figures 1-5) over the area of interest to support my conclusions that although there are a few weak patterns and some anomalies, there is very little indication of anything going on in the dump material below the fill. The enclosed colour composite shows the tremendous variation both spatially and spectrally of the area surrounding the waste dump, while the dump itself at the larger scale is homogeneous in composition and has consistent spectral characteristics across the entire area. The colour pseudo-contour map (Figure 2) illustrates that all of the close-up patterns that are discussed are gleaned from calibrated temperatures that range over a maximum of 2°C and in fact mainly within a 1° range – so these are very weakly detectable. Figure 2 also shows a pattern of increasing temperatures (within the 2° range) as you descend to the lowest levels of the dump. This could be due to slight increases in moisture, but may also simply reflect the lower altitude and different atmospheric conditions as you move down toward the valley. Figures 3 to 5 show various other patterns in the mid-wave evening, morning and thermal inertia bands.

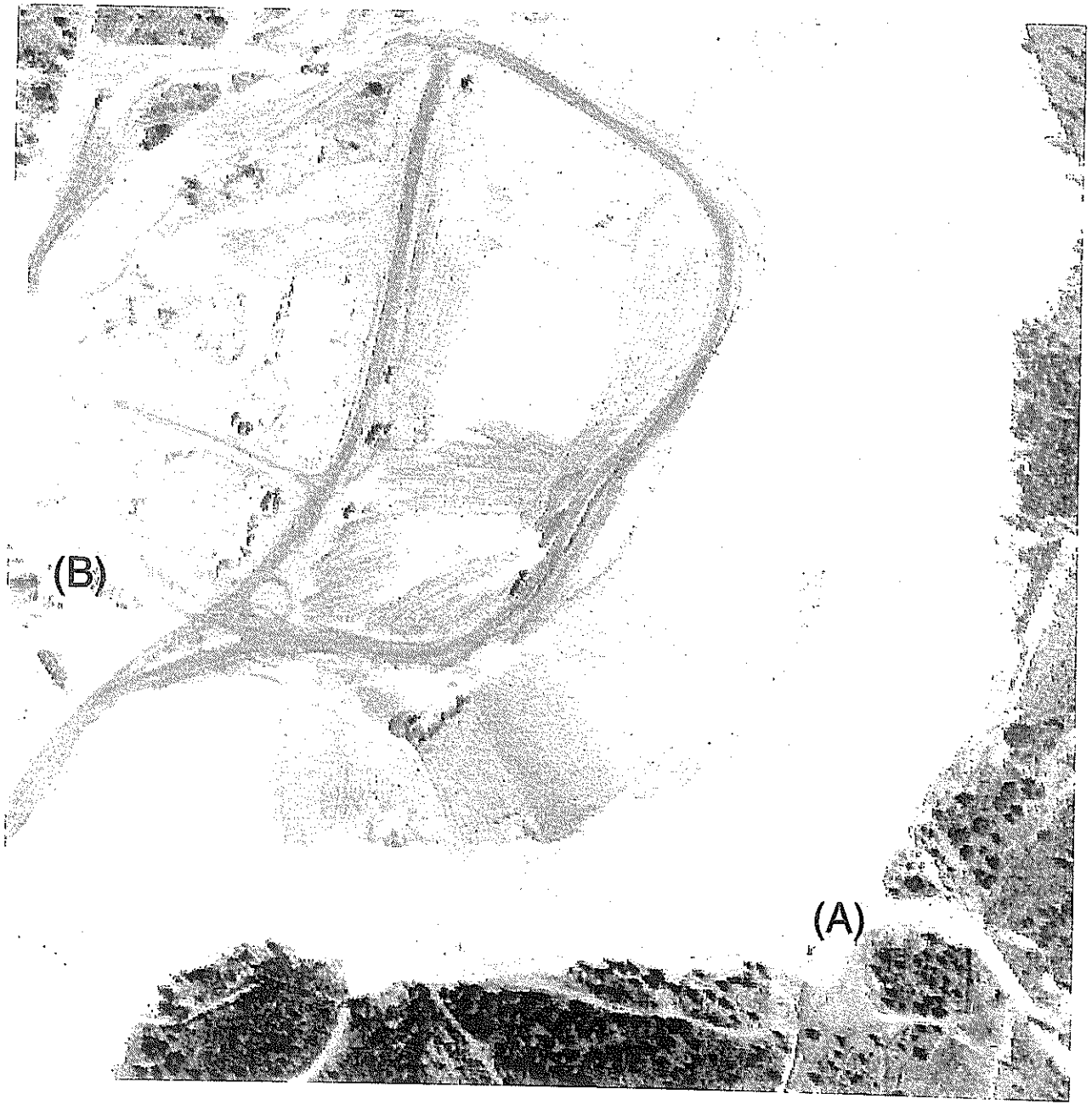
I can't be certain of any interpretation without some study or field checking, but I think the anomalies labeled A, B, and C on these last three figures are due to varying amounts of moisture in the till. Bruce Donald also suggested that some of them might be areas that were not recently ripped in preparation for seeding as a few areas are designated for trees. If the variations are due to moisture, then I would suspect that the dark areas (A) might represent seeps as they stay cool and change very little in temperature. The warmer patches above these (B) may be due to elevated moisture in the till above, where daytime sun can warm the moist soils up almost to the temperature of the surrounding till. After sunset, the drier soils around these patches cool faster and we see relatively elevated readings in the morning above the wetter "seeps" below, if that is what they are. The two areas on top of the dump (D) in Figures 4 and 5 may be similar damp soils. The warmer slope shown as (C) on the figures is difficult to interpret for three reasons: they may be close to outcrop in places at the western edge of the dump and we can see greater variation in the till patterns to the west of the road where bedrock is closer; parts of this area are close to the portal above where there seems to be an anomalous and difficult to explain pattern, possibly due to warmer air from old workings; and finally, a look at the orthophoto seems to show that the till cover over this particular area is slightly darker and redder than in other areas.

I suspect the three extra strips we are still waiting for will be easier to interpret with some confidence now that I've taken the time to look at the main area in detail. We will only have mid-wave thermal data (both morning and evening), but it will be similar in sensitivity and resolution. As they were taken at the same time as the main survey, it should be possible to approximately calibrate the data to absolute temperatures calculated by the long wave instrument over the waste dump. These last three lines were taken over the old Iron Tailings Pond, the Open Pit area, and the Lower Mine Yard Dumps. Data should be available next week.



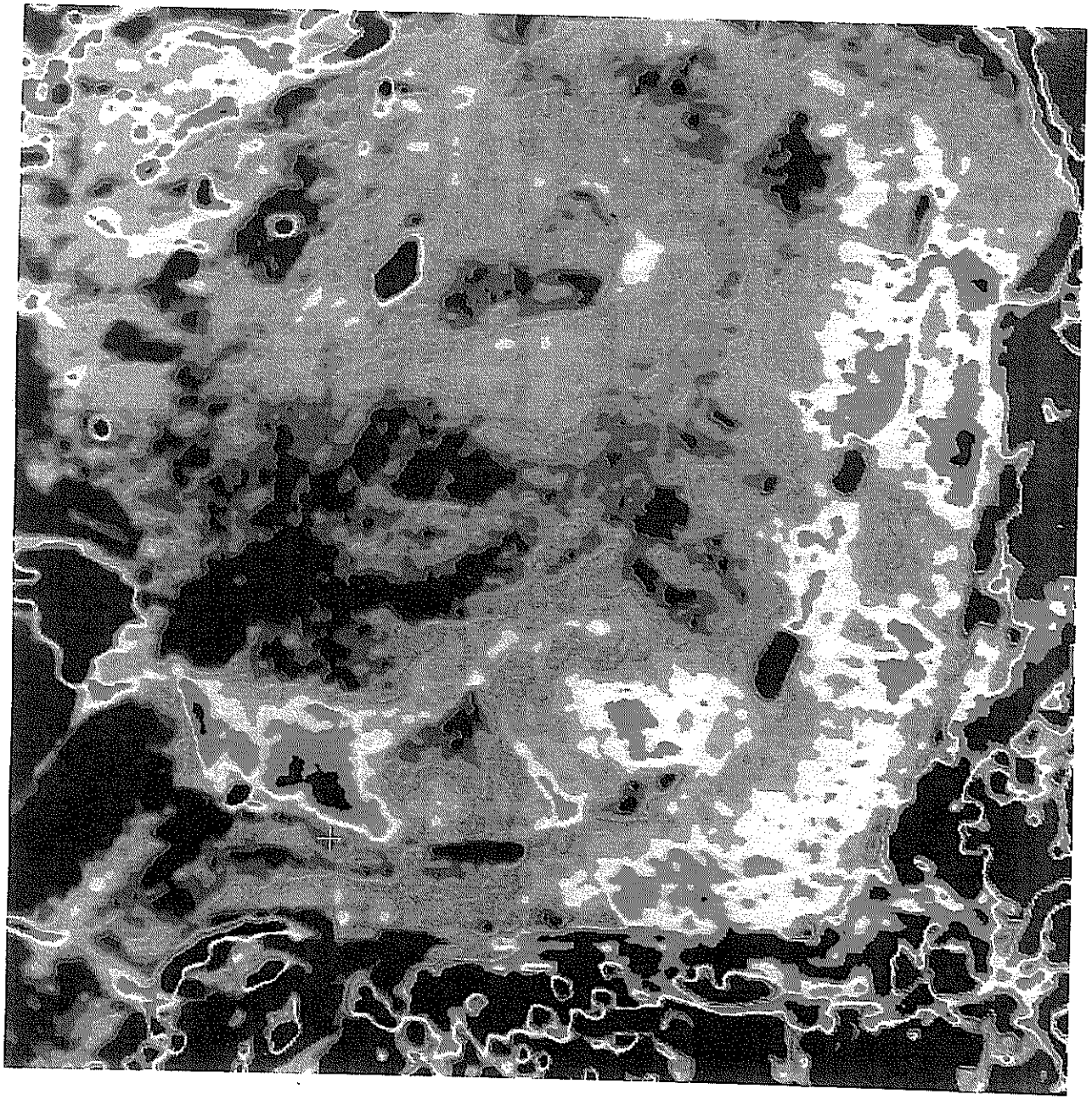
Sullivan No. 1 Waste Dump

Airborne Thermal Infra-red Image Acquisition, May 30th and May 31st, 2006.



Sullivan No. 1 Waste Dump
Digital Orthophoto

Figure 1. Full resolution air photo flown over the Sullivan Lands in August, 2005. Distance across the close-up image is 500m. The shed (A) where the accidents occurred is on the southeast flank of the dump. The mine portal (B), still open to the underground workings is also shown for reference.

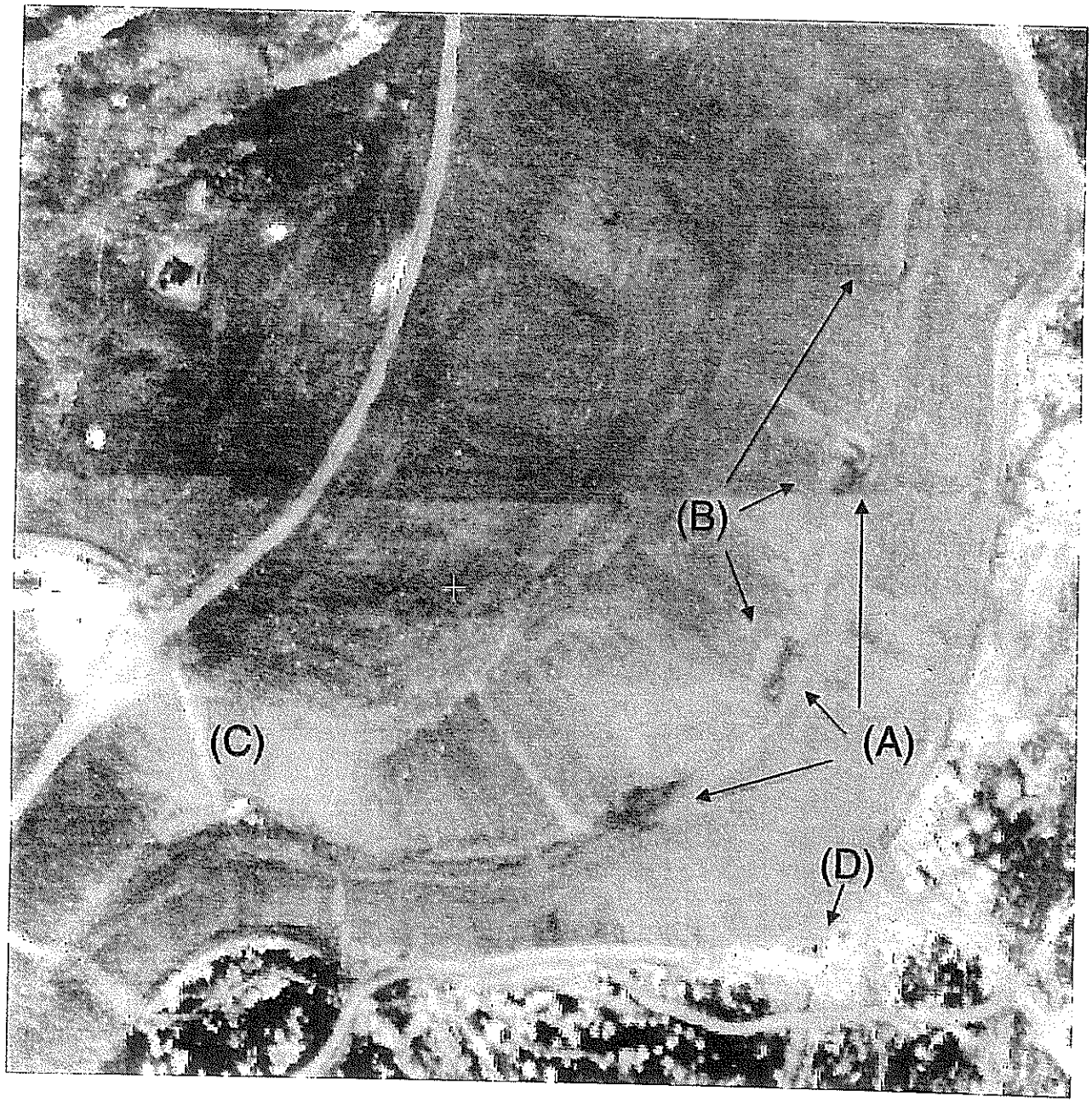


Sullivan No. 1 Waste Dump Long-wave Thermal IR Image, May 30th, 2006.

Figure 2. Calibrated surface temperatures from Long Wave Thermal Infra-red flight data acquired just after sunset. Black areas within red areas slightly exceed 6° C while black within blue represents slightly less than 5° C. Temperature range across the entire scene is about 2° C. Generally, warmest areas are on the lower flanks of the dump, perhaps reflecting moisture content in the till or elevation differences.

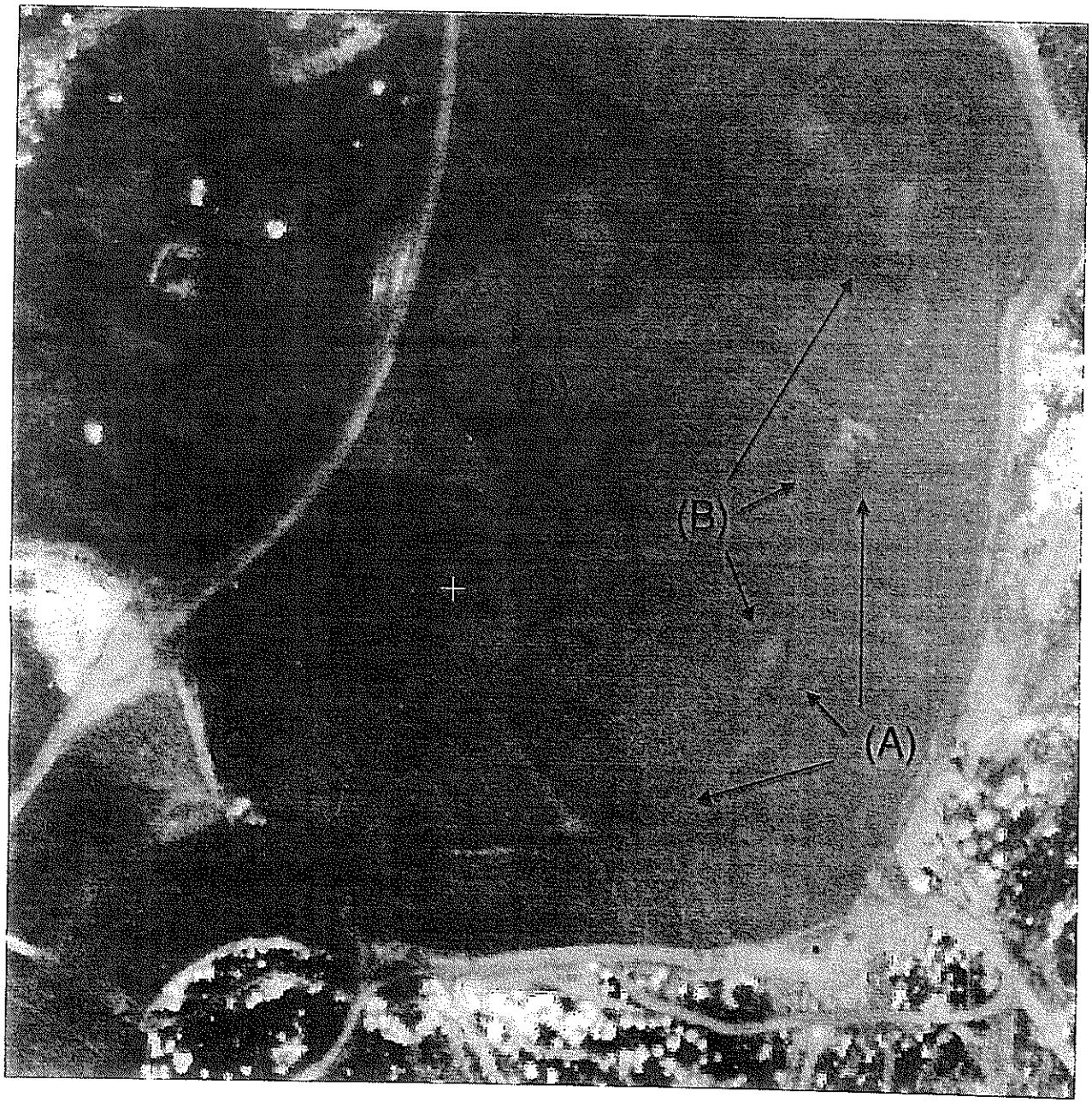
6° C

5° C



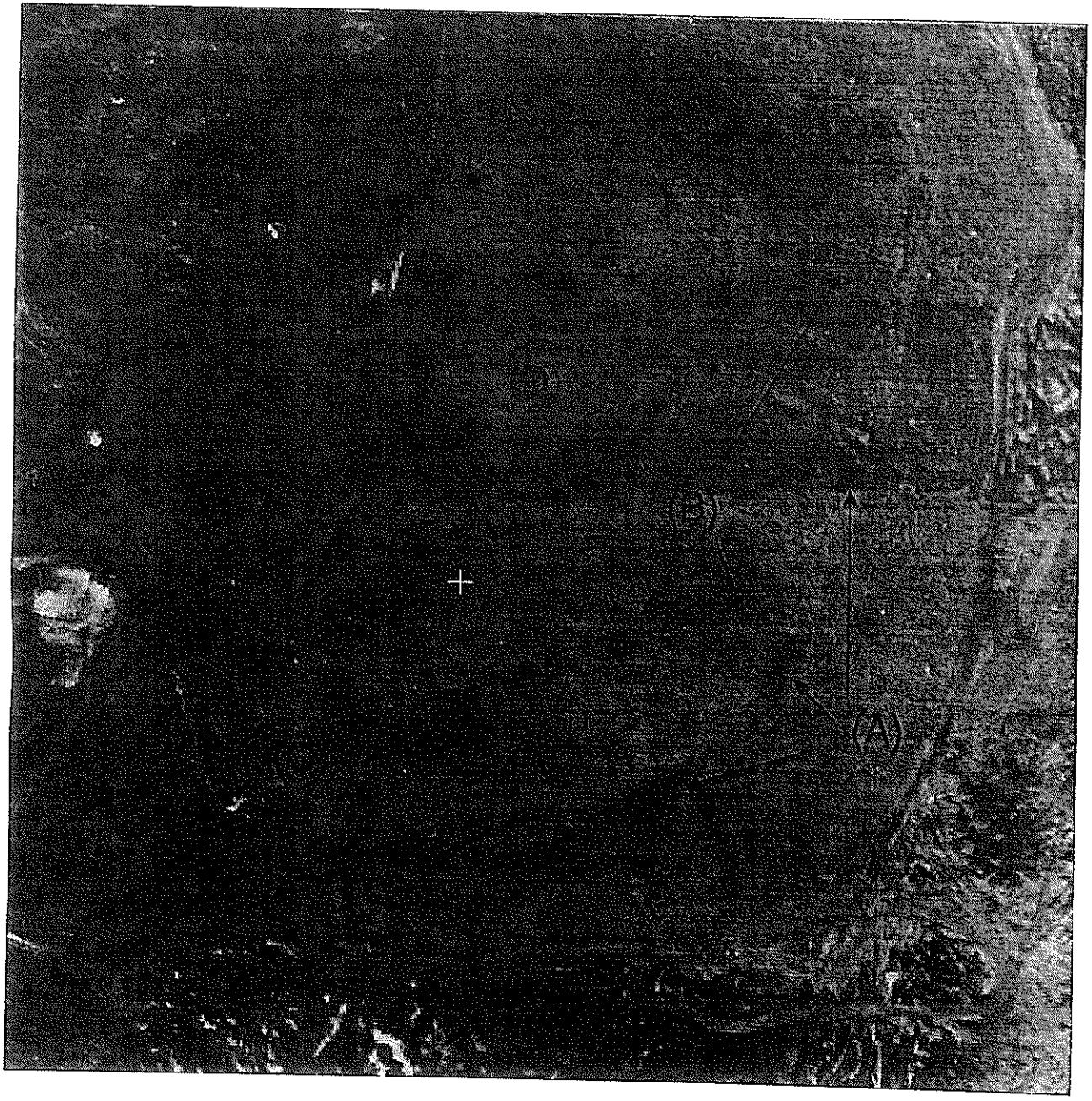
Sullivan No. 1 Waste Dump Evening Mid-wave Thermal IR Image, May 30th, 2006.

Figure 3. The till covering the dump appears homogeneous. Dark cool areas (A) at the base of the steep slope are probably due to moisture. Immediately above these patches (B), the till is very slightly warmer than surrounding material. These lighter, warm areas show clearly in the scene taken the next morning. The steep slope (C) just to the east of the main portal is the warmest area on the dump during the day time. The shed where the accidents occurred is the small dark square on the southeast flank of the dump (D). Also apparent on the image are the lighter drainages, or erosional channels that cut down the steep slope. The jagged horizontal line across the middle of the image is the "seam" where 2 flight lines have been joined together.



Sullivan No. 1 Waste Dump Morning Mid-wave Thermal IR Image, May 31st, 2006.

Figure 4. This mid-wave thermal image was acquired just before sunrise, about 6 hours after the evening image. The images are quite different, and the difference between them (Figure 5) can be used to determine the thermal inertia characteristics of different materials on the ground. In the morning image, the light, relatively warmer areas (B) at the base of the slope are now more pronounced than the darker areas (A) that showed up well on the evening shot. The slope at (C) has remained lighter than the surrounding till and two new warm spots (D) are now evident. These new anomalies are on the highest part of the dump where it is flat and probably represent moisture in the till where it collects runoff from the road. This image shows all of the major areas that should be field checked.



Sullivan No. 1 Waste Dump Thermal Inertia Image.

Figure 5. Dark areas indicate areas that have changed temperature the least between evening and morning, while lighter shades indicate the greatest amount of cooling. The dark areas at (A) have stayed cool throughout, while the (B) anomalies have stayed relatively warm as reflected in the morning mid-wave scene. The slope at (C) has stayed relatively warmer just east of the portal as the darker shade here indicates that this area has changed less than others on the steeper sloped part of the dump. The different characteristics on this part of the dump may be due to different till composition as the orthophoto seems to show a darker brown colour here. The area at (D) has cooled down less than other parts of the dump. The smooth outlines of this area seem to re-enforce the idea that this patch is related to moisture in the till.

Nad 83 - UTM Zone 11

Sullivan Mine No. 1 Waste Dump

August, 2005 Digital Orthophoto

Scale 1:5 000

100 0 100 200 300 400 500 Metres

Transverse Mercator Projection

Sullivan Mine No. 1 Waste Dump
Airborne Thermal Infrared Survey Colour Composite

Datum 83 - UTM Zone 11

Legend

- Mid-wave Thermal IR (evening flight)
- Mid-wave Thermal IR (morning flight)
- Thermal Inertia

Sullivan Mine No. 1 Waste Dump

Airborne Thermal Infrared Survey Colour Composite

Scale 1:5 000

100 0 100 200 300 400 500 Metres

Transverse Mercator Projection

Sullivan Mine No. 1 Waste Dump
Airborne Evening Mid-wave Thermal Infrared Survey, May 30, 2006

NAD 83 - UTM Zone 11

Sullivan Mine No. 1 Waste Dump

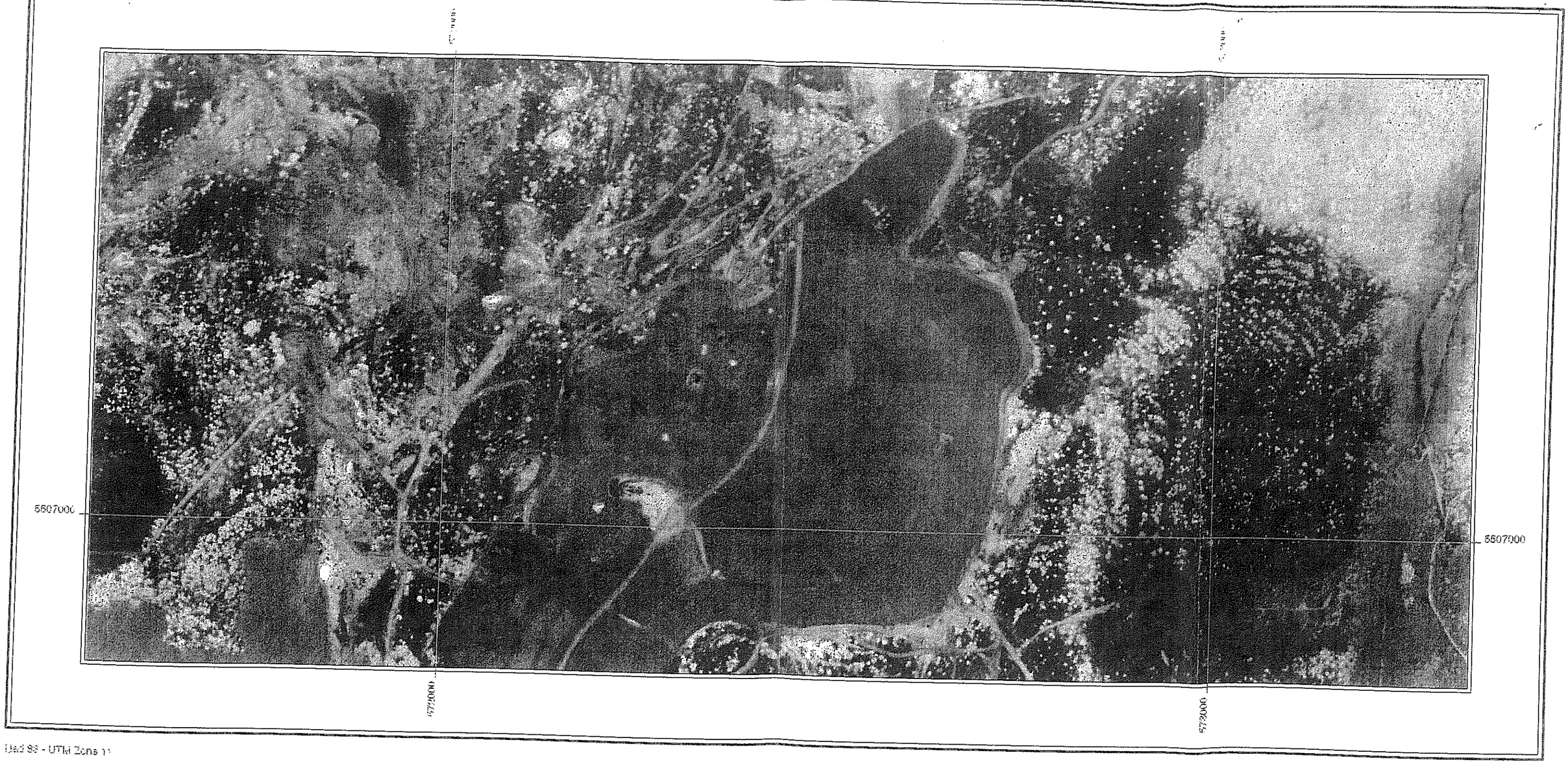
Airborne Evening Mid-wave Thermal Infrared Survey, May 30, 2006

Scale 1:5 000

100 0 100 200 300 400 500 Metres

Transverse Mercator Projection

Sullivan Mine No. 1 Waste Dump
Airborne Morning Mid-wave Thermal Infrared Survey, May 31, 2006



Nad 83 - UTM Zone 11

Sullivan Mine No. 1 Waste Dump

Airborne Morning Mid-wave Thermal Infrared Survey, May 31, 2006

Scale 1:5 000

100 0 100 200 300 400 500 Metres

Transverse Mercator Projection

Nad 83 - UTM Zone 11

Sullivan Mine No. 1 Waste Dump

Airborne Thermal Infrared Survey - Thermal Inertia

Scale 1:5 000

100 0 100 200 300 400 500 Metres

Transverse Mercator Projection

Gas and Water Sampling Report
#1 Waste Dump Monitoring Shed
Sullivan Mine Fatalities 19 May 06

Al Hoffman, P.Eng.
Manager, Occupational Health
Ministry of Energy, Mines and Petroleum Resources
August 2006

1. Introduction:

As a result of an accident involving four fatalities in a water monitoring shed at the Sullivan Mine #1 Waste Dump, gas and water samples were acquired in the early morning hours of Friday May 19, 2006 starting at 1:37 am,. Water samples were collected to determine if the water effluent flowing through the sump area of the shed could be a significant source of off-gassing and worker exposure.

This report confines itself to the gas and water sampling that was conducted by the Ministry of Energy, Mines and Petroleum Resources (MEMPR) and the Teck Cominco HAZMAT team in the early morning hours of Friday, May 19, 2006. Some broader conclusions will be drawn from work that was undertaken by Teck Cominco and Rescan Environmental Services Ltd.

2. Methodology

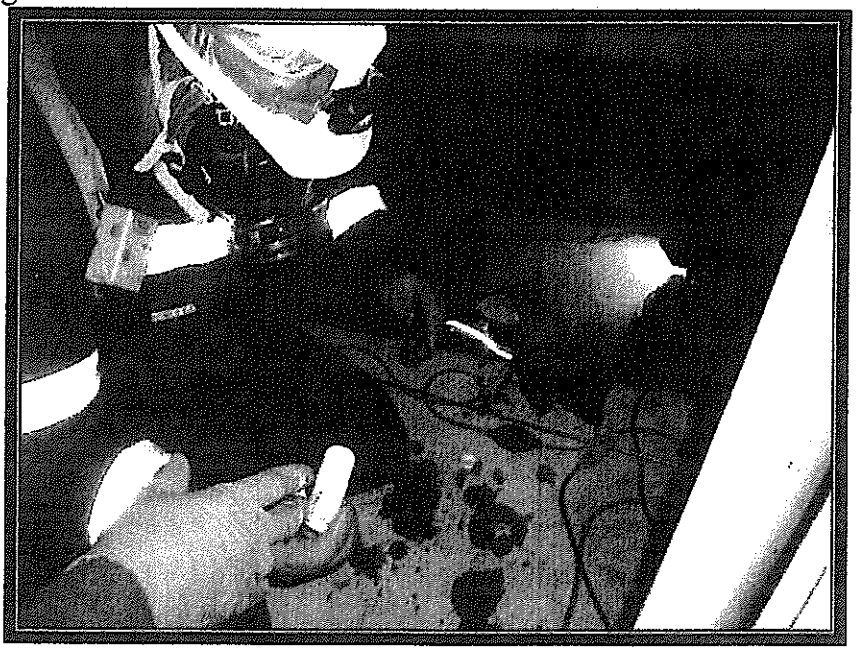
A drawing illustrating No. 1 Waste Dump Monitoring Shed as-built drawing is attached as Appendix 1. A complete review of the water sampling shed location and sampling protocols is outlined in the Teck Cominco portion of the fatality report.
The water sampling shed was located on the toe of the No. 1 Waste Dump. It was constructed over a weir that was used as a location to sample both the volume and quality of water that was seeping through the dump and collected in a French drain running along the toe of the dump. Water exiting the French drain was collected in a 400 mm HDPE pipe that was enclosed in a culvert and buried with rock and fines. The effluent then flowed across the sump floor and exited the monitoring shed via a smaller diameter 200 mm HDPE pipe. After leaving the immediate toe area of the dump, the effluent flowed downhill to another sampling shed located at the 3700 Level portal and eventually into the St. Mary's river treatment plant.

Workers periodically entered this shed to measure the volumetric flow rate of water passing through the shed and to and collect water samples for further analysis.
A photograph showing a member of the HAZMAT team entering the sampling shed is shown in Figure 1 below:

Figure 1 Team member enters the water monitoring shed.

A total of nine gas bag samples were collected from three locations in the sampling shed using a sampling train consisting of a metal probe, plastic tubing and a squeeze bulb. Three control samples were collected in fresh air approximately 200 yards upwind of the site. All samples were collected in one litre Tedlar gas bags.

Water samples were also collected from the inlet pipe at the bottom of the shed sump as shown in Figure 2.



All samples were collected by the Teck Cominco HAZMAT team. Team members wore self-contained breathing apparatus and followed their applicable company emergency

procedures. After the samples were collected, they were sealed in coolers with legal tags and transported by road to the ALS Laboratory facilities in Edmonton, Alberta for analysis.

3. Results:

The water sampling results did not show a significant source of off-gassing . No bubbling of the water effluent was noted at the time of collection.

The Teck Cominco HAZMAT team noted a significant inflow of air entering the shed via the upstream 400 mm HDPE pipe. Air velocities reaching 180 fpm exhausting the inlet pipe were estimated using a velometer. Given that the inlet pipe was approximately half full with sediment, the incasting volume of air was approximately 125 cfm.

Table I below summarizes the sampling location and analytical gas sampling results. The complete gas and water analytical results are attached in Appendix 2. One set of samples was retained for legal purposes by ASL Laboratories. The third set of samples was retained by Teck Cominco Ltd. for possible further analysis.

Table I Summary of Sampling Results Conducted Friday May 19th 2006 starting 1:37 am

Sample Location	Sample No	Oxygen ppm	Carbon Dioxide ppm	Nitrogen %	Carbon monoxide ppm	Hydrogen Sulphide ppb
Centre of Inlet Pipe	1B Pipe Air	2	59000	92	<1	<10
1ft < floor grade	2B below grade	2	57000	91	<1	<10
5ft> floor grade	3B above grade	18	10000	80	<1	<10
200 yards west of shed	Clean Air 2	21	49	78	<1	<10

The sampling results in the sump area illustrate that oxygen levels were far below normal levels of approximately 20.9%. The literature indicates that exposures to oxygen levels in the range of 1 -2 % can result in immediate collapse. In fact, the diffusive process of oxygenating blood via the alveoli actually reverses at these concentrations(1). Oxygen flows from the victim's blood stream back into the ambient air. Death can result very quickly.

It is interesting to note that at a sampling location approximating the breathing zone at five feet above the shed floor, oxygen levels had only been depleted to approximately 18%. (2) found oxygen levels above the floor grade in the range of 12 to 20% Therefore, it is possible that the victims or other individuals entering the shed felt no ill effects if they did not descend the ladder to the sump area.

Nitrogen levels were enriched from normal levels of approximately 78.1% to a range from 80 to 92%. Nitrogen gas is considered to be an inert simple asphixiant; thus, the

negative health effects of elevated levels are generally associated with depleted oxygen as is the case in this circumstance.

Carbon dioxide concentrations ranged from 10,000 to 59,000 ppm. 2) found concentrations in the shed above the floor grade ranging from approximately 2500 to 30,000 ppm. The effects of enriched carbon dioxide levels have also been described in the literature. Exposures at 30,000 ppm have resulted in reduced hearing acuity, increased blood pressure and pulse rate. Signs of intoxication were produced by a 30 minute exposure at 50,000 ppm (3). Although concentrations of carbon dioxide were elevated in the monitoring shed, it is very unlikely that the carbon dioxide levels found would solely cause the immediate collapse of those fatally injured.

The hydrogen sulphide (H_2S) analytical results were less than the detectable limits of 10 ppb. The current MEMPR threshold limit value (TLV) for H_2S is 10 ppm or 10,000 ppb (4).

Carbon monoxide levels were found to be less than the detectable limit of 1 ppm. The current MEMPR TLV for CO_2 is 25 ppm (4).

4. Conclusions:

Oxygen depletion appears to be the immediate cause of collapse and consequent death of the victims. Carbon dioxide levels, although elevated, would probably not have solely resulted in the collapse of the four individuals. Neither elevated carbon monoxide nor hydrogen sulphide gas levels were found in the sampling shed. Nitrogen levels were elevated but this was a result of the oxygen depletion of incasting air from the waste dump.

5. Recommendations

RESCAN, a consulting company collected additional water and air samples on the morning of Saturday May 20, 2006. A complete review of these results should be undertaken to see if the conclusions stated above are supported.

Teck Cominco is developing an onsite sampling program to determine the reaction that is occurring in the waste dump which resulted in the oxygen depletion of the incasting air. A permanent sampling facility will be build adjacent to the monitoring shed.

Specific recommendations to reduce the likelihood of similar fatalities are located elsewhere in the fatality report.

References

1. **Hazards and Risks of Confined Spaces, Oxygen and Deficiency,** Government of Western Australia SafetyLine Institute publication Level 1 Course 8.

2. **Sullivan Mine Incident Investigation, May 15 to May 20th 2006,** Prepared by Rescan Environmental Services.

3. **Carbon Dioxide Threshold Limit Value Criteria,** American Conference of Governmental and Industrial Hygienists, 2001.

4. **Health, Safety and Reclamation Code for Mines in British Columbia,** Part 2, Table 2-1, published April 2003.

BRITISH COLUMBIA

MINISTRY OF PUBLIC SAFETY AND SOLICITOR GENERAL

BC CORONERS SERVICE

MEMO

TO:	Fed Hermann	**FROM:**	Bruce Chamberlayne
TITLE:	Chief Mining Inspector	**TITLE:**	Regional Coroner
DEPT:		**DEPT:**	
DATE:	July 14, 2006	**CC:**	

SUBJECT: Final Autopsy, Toxicology and Neuropathology Reports

Hi Fred,

This is a copy of the final autopsy, toxicology and neuropathology reports for Douglas Lloyd Erickson. The medical findings for Mr. Erickson and the other victims were identical. Our investigation confirms that the sampling site was low in oxygen and no other factors were causal or contributory towards their deaths.

I will be in touch in late August to set up a conference call with WorksafeBC and ourselves.

Regards,

Bruce

Bruce.Chamberlayne@gov.bc.ca